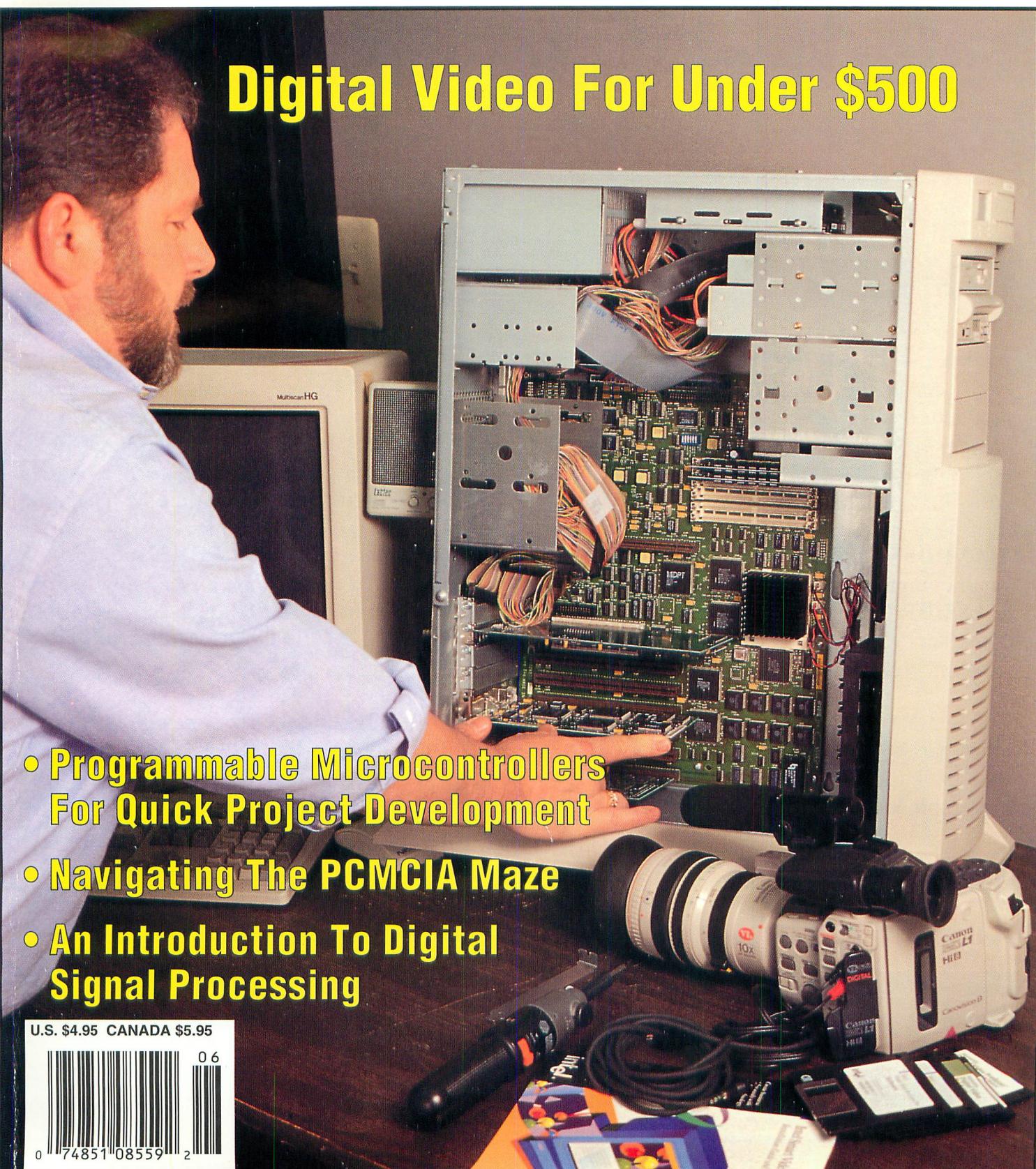


# MicroComputer JOURNAL

*The print forum for the MicroComputer professional and semi-professional*

May/June 1995

## Digital Video For Under \$500



- **Programmable Microcontrollers For Quick Project Development**
- **Navigating The PCMCIA Maze**
- **An Introduction To Digital Signal Processing**

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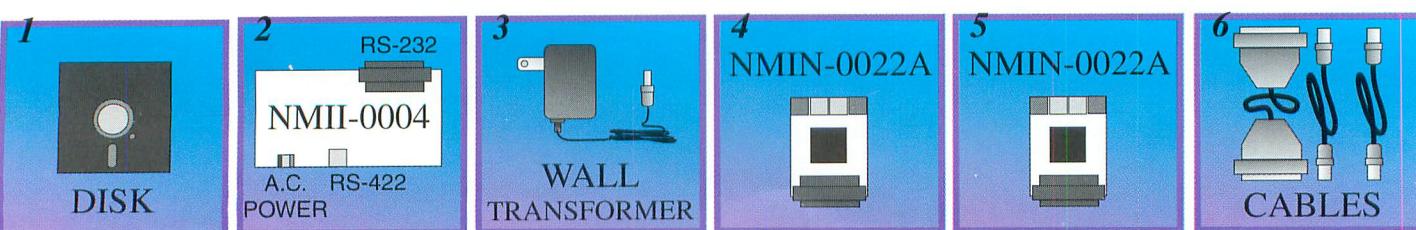
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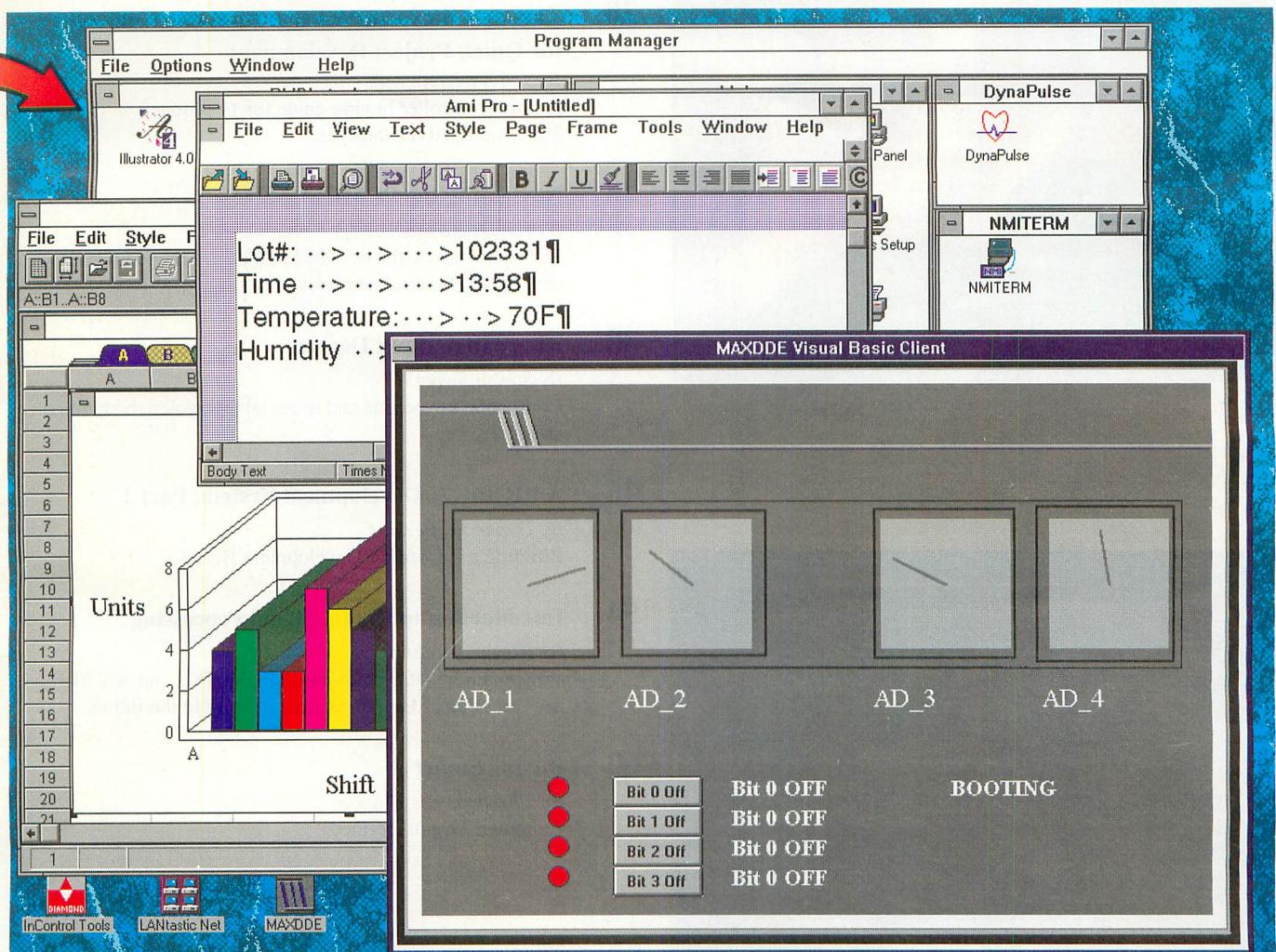
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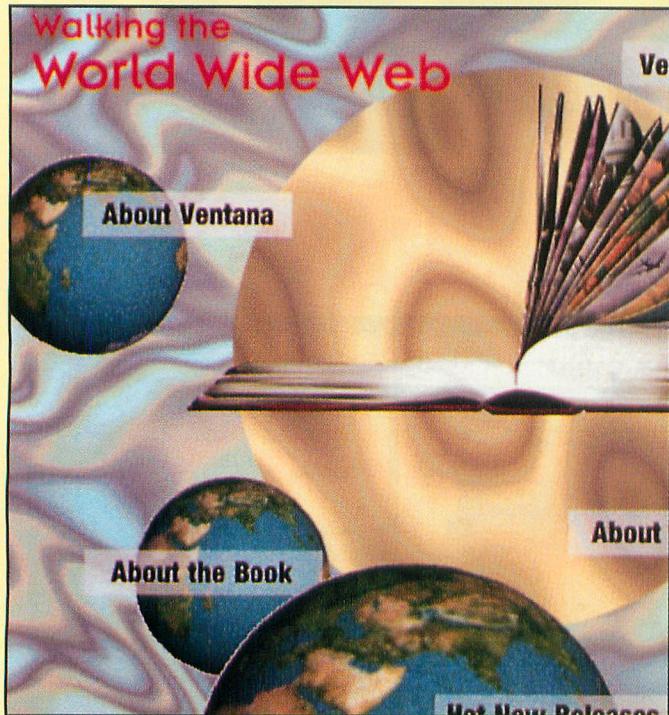


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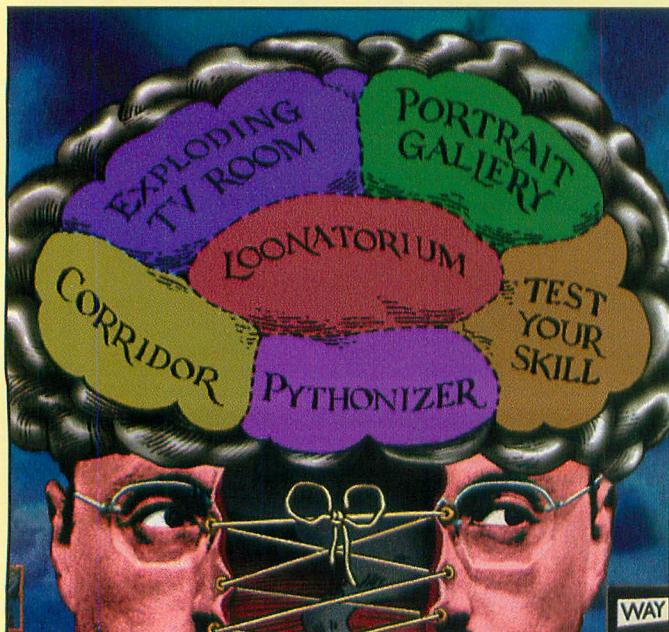
CIRCLE NO. 80 ON FREE INFORMATION CARD

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## In This Issue

It seems that with each new issue, the DOS/Windows-based PC platform becomes a more-sophisticated tool with which users can expand their creative horizons. A good case in point is the ability to capture and view video on your desktop PC with a less-than-\$500 hardware/software package from Intel. Tom Benford tells you all about it in "Digital Video—Now You Can Do It and View It On Your Desktop PC" beginning on page 12.

Those of you who are into developing microcontroller projects will want to zero in on Jan Axelson's "Tiny and Inexpensive Programmable Controllers for Quick Project Development" beginning on page 20. Jan provides a buying guide for a variety of microcontroller development systems in three popular families.

PCMCIA has yet to become a trouble-free, user-friendly environment, but it's getting there. Joe Desposito helps you in "Navigating the PCMCIA Maze" with the basics, details of the new PCMCIA Card Standard and in-depth looks at two interesting new PCMCIA products beginning on page 28.

If you've been the victim of physical-stress problems (or know someone who is) as the result of long hours at a PC, Steve Sweet gives you insights on input devices that are alternatives to standard keyboards in his article beginning on page 38.



Duane M. Perkins brings the do-it-yourself concept to microcontroller development systems with his "PIC16C71 Development System" beginning on page 46. In this first part, Duane gives details on how to build a Development Board. In future issues, he'll present add-ons that will team with the Development Board.

Looking ahead toward new technologies, Hardin Brothers provides an "Introduction to Digital Signal Processing" beginning on page 54. He gives insights into the how and why of DSP and tells why he feels DSPs will become standard in future PCs.

Finally, TJ Byers will make you a more canny computer-product buyer with his "Buying Smart: Computer Jargon Defined" article beginning on page 60.

In Microcomputer Q&A (p. 66), TJ Byers answers PC-related questions on all aspects of personal computing. Next, Yacco discusses "Windows Hardware" in his GUI Guts column (p. 70). Then it's on to some fascinating products, with Tom Benford as host in his Multimedia column (p. 76). Ted Needleman serves up reviews of four diverse products every PC user will want to have on his desktop in his Microcomputer Musings (p. 82). Joe Desposito talks about "Add-Ons to Enhance Portable Computing" in his Computing On The Go column (p. 88), and John Hastings is back with late-breaking news on the personal-computing scene and market trends for used PC equipment.

**Cover Photo By Joe Abbato/The Photography Place**

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# Late Retirement

The excitement of welcoming new computer devices continues. But are they all that new? Not really. Generally, they're embellishments or enhancements. But looking back at what they were in the early stages, they do appear to be "new."

Just consider the PC launched by IBM/Intel/Microsoft in 1981. The present platform extends from an X86 architecture. Changes here, modifications there, and we move from an eight-bit bus to a 16-bit one to 32-bit one and now to a 64-bit one. In between, various buses were developed, such as the VESA Local Bus and PCI bus. The latest and greatest Pentium will be overshadowed in time by the upcoming Intel P6 microprocessor. Microsoft operating systems are continually upgraded, too, as you know.

All of it, however, builds on rather old technology that many people feel should have been retired some time ago. Their constraints have been on display for some time now, notwithstanding the clever ways of getting around a 640K ceiling and other improvements.

Don't think that PC technology is alone in this respect. Just look at the venerable Intel 8051 microcontroller, introduced in 1980! This eight-bitter has more lives than a cat. It has variations upon variations. They are, like the X86 microprocessor technology, largely backward compatible with their ancestor. The latest forms, like Intel's MCS 251 modification of the 80C51, uses an 8051 superset, though it also has some 16-bit operations. Dallas Semiconductor, too, has redesigned an upgraded 8051, the eight-bit 8052, as its DS87C520, which is also pin- and code-compatible with its progenitor.

Motorola also knows how to hang on to a good thing. Would you believe

that its 6800 architecture was introduced in 1979? It's still going very strong in its latest incarnation, the 68060, which is somewhat similar in action to Intel's Pentium.

But bus developments are different. PCI looks like it will wipe out the ISA bus, for example. In time it likely will. But don't overlook the 14-year-old VMEbus, so popular in computer workstation machines. It, too, gets regular facelifts. There's a VME64 specification in the making, which would double the bandwidth of the bus to a maximum 80M per second. Moreover, there are 200M/s proposals.

Isn't it amazing that there are so few fresh beginnings? Out with the old and all their hindrances, you might say. If you do, however, you'll be overlooking one of two interesting considerations. One is, of course, the really large user base out there that backward-compatibility continues to hold on to. The second consideration is that many users really don't need the latest and the greatest. For example, many industrial control systems do not at all require faster bus speeds.

All this has left us with archaic designs that our best engineering minds regularly spruce up. But we surely must be coming close to retiring the basic structure that's been worked and reworked to death. They represent an extraordinary retirement extension. Soon they'll be ripe. Perhaps that's what Apple senses in collaboration with IBM and Motorola. Their PowerPC challenge to the dominant forces in the PC world will test the water as young Turks trying to push out the elders into the green pastures.



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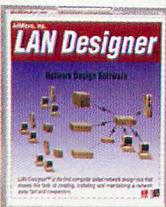
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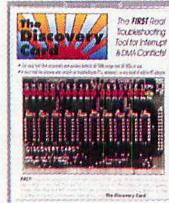
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### What's Happening!

ID'ING YOUR CPU. There are plenty of programs that identify your CPU. But you might want to add Intel's free one that identifies if you have a flawed floating-point divide Pentium, as well as ID'ing other Intel CPUs in your machine. Just download it from Intel's Bulletin Board Service by calling 503-264-7999. It's in the CPU/Over-drive/Math Coprocessor section as \$CPUID.EXE.

At the same time, you can read about Intel happenings, such as its anticipated P6 microprocessor coming up in mid-1995. It contains the equivalent of 5.5-million transistors, as compared to the Pentium's 3.1-million.

MICHELANGELO PETERS OUT. Well, March 6th passed without much ado insofar as the Michelangelo software virus is concerned. Three years ago, it infected more than a million PCs on this date. Anti-virus programs have cut down the infections considerably. However, there are plenty of other viruses lurking around to attack at any time—more than 5,000, in fact. Since new ones crop up continually, anti-virus programs have to be regularly updated. In keeping with the Michelangelo anniversary, Peter Norton group of Symantec provides a free special edition of the Norton Anti Virus software. Use the company's bulletin board (tel.: 503-484-6669). It's also available from America Online (Symantec), CompuServe (GO Symantec) and World Wide Web ([www.symantec.com](http://www.symantec.com)).

HOME OFFICE LIFESTYLE. A major lifestyle change in U.S. households has occurred, according to a new nationwide survey by RKS Research & Consulting, North Salem, NY. According to data tracked over five years, the new study shows that more Americans are working from their homes. According to the November 1994 study, more than one-third of U.S. homes (34%) contain at least one computer and 29% maintain a separate home office. Of these users, 39% use this space to operate a home-based business; 11% use their offices for telecommuting.

ON-LINE JOB HUNTING. Used to be that you had to scour the Help Wanted ads in Sunday newspaper editions. Now there are employment announcements on-line. A new Internet-based job advertising service, JobWeb from Risetime, Inc., Schaumburg, IL, provides companies with display ads, which can employ full color, for a reportedly much lower cost than traditional media. Candidates can search for jobs by skills, be accessed on-line at a World Wide Web address: <http://www.jobweb.com/preview.html>. JobWeb itself can be reached at <http://www.jobweb.com/>.

If you're looking for computer jobs only, you might try the National Software Employment BBS (NSEBBS) at 800-860-7860. Developed by Sparrow Software, Inc., S. Burlington, VT, the system handles modem speeds through 14.4K bps (8N1) via Xmodem, Ymodem, Zmodem and Kermit protocols. New users can dial up a demo before opening an account. The company says it has over 15,000 computer-related job ads from 17 U.S. cities.

ATA PACKET INTERFACE GAINS MOMENTUM. A new standard application programming interface language, called ATASPI, is being proposed to ANSI (American National Standards Institute) for adoption by the computer industry. It supports enhanced IDE hard-disk drives in DOS and Windows environments to work with ATASPI CD-ROM and Tape drives. As an I/O manager, ATASPI handles packetized and non-packetized bus requests, overlapped I/O, 32-bit Access under Windows multiple ATA buses. Future Domain, a leading SCSI (small computer system interface) controller maker, is spearheading adoption of ATASPI and, thereby, expanding its focus on the desktop I/O market.

NEW LINUX OS. Trans-Ameritech, Linux Operating System and UNIX/GNU-related software maker and distributor, has an inexpensive but powerful UNIX clone, Linux Plus CD-ROM, which runs directly from CD-ROM for \$39.95. You can get the company's new installation and new-user guide, the 200-page Linux Encyclopedia for only \$10 instead of \$19.95 with purchase of the Linux Plus CD-ROM. The new flavor of UNIX is rapidly gaining popularity. For more information, call 408-727-3883 or e-mail: [Roman@Trans-Ameritech.com](mailto:Roman@Trans-Ameritech.com).

# Space-age speaker defies physics by breaking the sound barrier

Recoton develops wireless speaker technology that "clones" your stereo, providing stereo music 150 feet through walls, ceilings and floors.

by Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

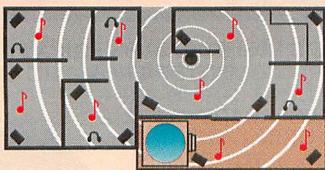
**Recently approved technology.** In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.



## 150 foot range through walls!

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 70,000 square foot area.

cally constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new

## Crystal-clear sound anywhere.

Just imagine listening to your stereo, TV, VCR or CD player in any room of your home—without running miles of speaker wire. Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel distances of up to 150 feet through walls, ceilings and floors without losing sound quality.

## A single transmitter, unlimited receivers.

The powerful transmitter plugs into an audio-out, tape-out or headphone jack on your stereo or TV component, transmitting wirelessly to speakers or headphones. The speakers plug into an outlet. One transmitter broadcasts to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built-in receiver/amplifier, there are no wires running from the stereo to the speakers.

## Full dynamic range.

The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new



Breakthrough wireless speaker design blankets your home with music.

technology provides static-free sound in virtually any environment. The speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

**Stereo or hi-fi, you decide.** These speakers have the option of either stereo or hi-fi sound. Use two speakers (one set on right channel and the other on left) for full stereo separation. Or, if you just want to add an extra speaker to a room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen for hi-fi sound.

**Factory-direct savings.** Our factory-direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 90-day risk-free home trial."



**Add headphones and save \$100.** For a limited time, when you order two speakers and a transmitter, you can add wireless headphones for only \$49. That's a savings of \$100 off the price of the headphone system. This exclusive offer is available only through Comtrad. Your order will be processed within 72 hours and shipped UPS.

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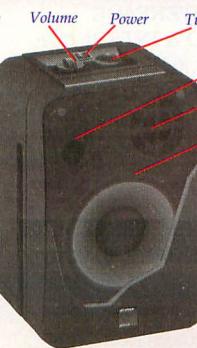
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**Don't take our word for it.** Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge**. Compare Recoton's rich sound quality to that of any \$200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 90 days for a full "No Questions Asked" refund.

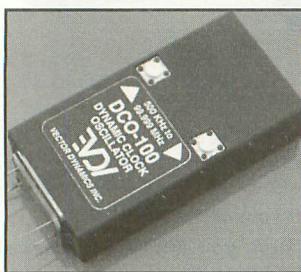
Recoton's Design and Engineering Award



### Hardware

#### Dynamic Clock Oscillator

The Vector Dynamics DCO-100 Dynamic Clock Oscillator plug-in substitute for standard four-pin fixed-frequency clock oscillators is a self-contained test instrument that provides user-selectable clock frequencies from 500 kHz to 99.9 MHz, in 1-kHz steps. The module is powered by the 5 volts normally provided to pin 14 of the clock oscillator in the circuit. This device comes with built-in display and "on-the-fly" programming buttons.



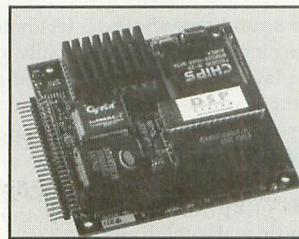
encies from 500 kHz to 99.9 MHz, in 1-kHz steps. The module is powered by the 5 volts normally provided to pin 14 of the clock oscillator in the circuit. This device comes with built-in display and "on-the-fly" programming buttons.

\$200. *Vector Dynamics, 1880 Tanglewood Dr. NE, St. Petersburg, FL 33702; tel.: 813-526-7038.*

CIRCLE NO. 1 ON FREE CARD

#### 50-MHz PC/104 Card

Saelig's TC486-50 double-clocked 50-MHz 486 PC/104 card includes two serial ports, up to 4M of RAM, two EPROM sockets and keyboard, mouse and sound ports. It runs from a single 5-volt

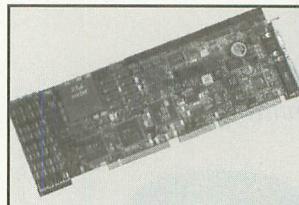


supply. \$699. *The Saelig Co., 1193 Moseley Rd., Victor, NY 14564; tel.: 716-425-3753; fax: 716-425-3753.*

CIRCLE NO. 2 ON FREE CARD

#### PCI-ISA SBC

The Teknor Microsystems PCI-930 486DX-based, passive-backplane industrial single-board computer operates at processing speeds up to 100



MHz. It's designed to the new PICMG Revision 2.0 industrial PCI specification and offers full PCI and ISA passive-backplane compatibility. \$1,595 for 486DX-50. *Teknor Microsystems, Inc., 616 Cure Bovin, Boisbriand, Quebec, Canada J7G 2A7; tel.: 514-437-5682; fax: 514-437-8053.*

CIRCLE NO. 3 ON FREE CARD

#### Computer-Monitor Signal Generator

Sencore's new Model CM125



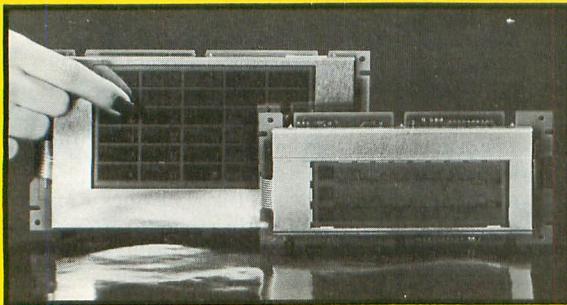
Computer Monitor Signal Generator is designed for testing computer video monitors. This programmable portable RGB generator features a video bandwidth out to 125 MHz and 2,048 x 2,048-pixel resolution. It's compatible with TTL, analog and ECL video types and has 100 monitor setup memory locations. A complete set of video patterns helps simplify computer video-monitor testing and troubleshooting. *Sencore, 3200 Sencore Dr., Sioux Falls, SD 57107; tel.: 1-800-SENCORE.*

CIRCLE NO. 4 ON FREE CARD

#### PC Labeler

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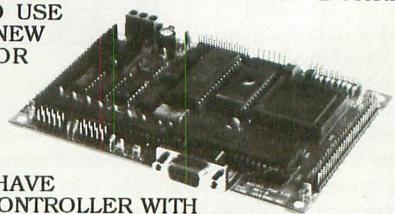
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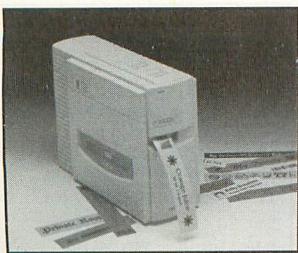


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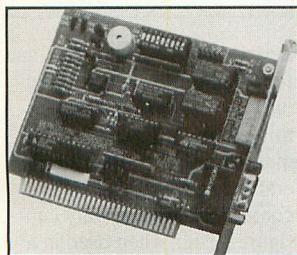


printer for IBM PC/compatible computers lets you print text and images onto laminated adhesive-backed labels. It offers high-quality thermal-transfer printing and a bitmap graphics-import feature. The one-piece tape cassettes come in five sizes that range from 1/4" to 1" wide. Windows-based labeling software is included. *Brother Int'l. Corp., 200 Cottontail Lane, Somerset, NJ 08875; tel.: 908-356-8880; fax: 908-356-4085.*

CIRCLE NO. 5 ON FREE CARD

## PC Watchdog

PC Watchdog from Berkshire Products is a system monitoring board that can re-start a PC that has malfunctioned. The

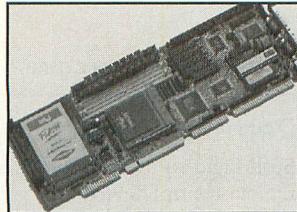


board is user-programmable. You can connect on-board relays to external devices to alert you in case of a watchdog reset. \$144.95. *Berkshire Products, 2180 Pleasant Hill Rd., Ste. A-5185, Duluth, GA 30136; tel.: 404-271-0088; fax: 404-932-0082.*

CIRCLE NO. 6 ON FREE CARD

## VESA SBC

The Granite Microsystems GMS486-VL single-board

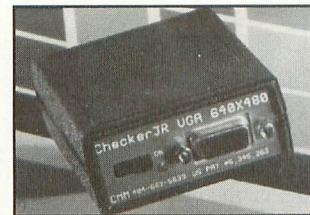


computer features a VESA local-bus design for use with passive backplanes and a dual PCMCIA interface. On-board features include a local-bus IDE controller, dual floppy-disk controller, two serial ports and a parallel port. The PCMCIA interface permits the system to be bootable from standard PCMCIA flash-memory cards, or it can be used with other PCMCIA peripherals. *Granite Microsystems, 10202 N. Enterprise Dr., PO Box 579, Mequon, WI 53092; tel.: 800-822-2983; fax: 414-242-8825.*

CIRCLE NO. 7 ON FREE CARD

## Video-Monitor Pattern Generator

Computer & Monitor Maintenance's Checker Jr. is a small hand-held, battery-operated computer color video-monitor



pattern generator that can drive virtually any VGA, SVGA or multi-scanning monitor. Checker Jr.'s pattern is an 8 x 8 arrangement of 64 different color blocks in a white grid. This pattern can be used to set the size, position, convergence, focus and color balance of a video monitor. \$99.95. *Computer & Monitor Maintenance, Inc., 6649-N1 Peachtree Ind. Blvd., Norcross, GA 30092; tel.: 800-466-4411; fax: 404-840-8814.*

CIRCLE NO. 8 ON FREE CARD

## Computer/Printer-Sharing System

ParaLink Pro printer-sharing system from Roa Electronics daisychains PCs through common telephone wire to create a mini-network of computers that can share a common printer or printers. Two small transmitters provided in a starter kit

## New Graphical Multimeters

The Fluke 860 Series family of three graphical test tools are high-accuracy, high-performance multimeters combined with analog, digital and graphical displays. These multimeters offer high precision, 32,000-count (4 1/2-digit) resolution, a dual digital display that gives additional information about the parameter being measured and an Analog NeedleGraph display.

Meter mode lets you directly measure current, resistance, conductance, capacitance, frequency, duty cycle, pulse width, period, decibels and ac and dc volts. The test tools also offer an AutoDiode feature.

Waveform display provides a clear picture of noise, waveform distortion, intermittent failures and glitches. TrendGraph mode plots high-resolution meter readings for up to 30 hours, in intervals ranging from 1 second to 15 minutes. In-circuit component test lets you view component signatures in-circuit, without having to remove and handle components. Logic test mode indicates logic transitions or state changes to 10 MHz and shows if a circuit is active or stuck high or low.

The Model 863 offers



meter and graphical capabilities, including meter mode, waveform display and TrendGraph mode. The Model 865 offers comprehensive meter and graphical capabilities, including meter mode, waveform display, TrendGraph mode, in-circuit component test and logic test mode. The Model 867 offers all the features of the Model 865 plus improved dc accuracy and an optically-isolated RS-232 cable and companion software. \$795/\$995/\$1,295. Models 863/865/867. *Fluke Corp., PO Box 9090, Everett, WA 98206; tel.: 800-44-FLUKE; fax: 206-356-5116.*

CIRCLE NO. 9 ON FREE CARD



plug into the parallel port of any desktop or portable computer. The supplied 25-ft. telephone cables plug into the RJ-11 jacks on the transmitters. The system permits file-transfer speeds up to 30K bits/second. Up to 32 PCs and eight printers can be connected together by purchasing the ParaLink Pro Expansion Kit or Receiver Kit.

ParaLink Pro offers an additional function that lets you

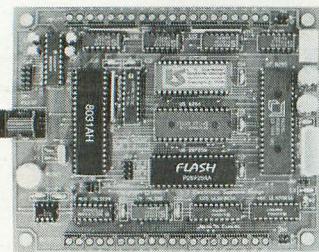
connect two PCs in a client/server relationship, using the DOS 6.0 and later InterLink application. \$249.95/\$69.95/\$69.95, Starter/Expansion/Receiver. *ORA Electronics, 9410 Owensmouth Ave., PO Box 4029, Chatsworth, CA 91313; tel.: 818-772-2700; fax: 818-718-8626.*

CIRCLE NO. 10 ON FREE CARD

## Notebook PCs

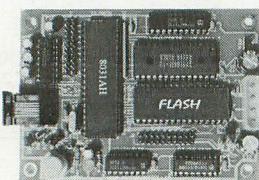
Epson's ActionNote 800 Series of notebook computers feature an embedded palm-rest trackpad pointing device and a 10.3" dual-scan passive or 10.4" active-matrix color LCD display. Three configurations are available. The 866C has a

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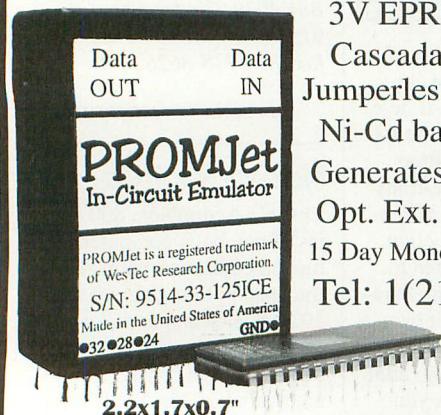
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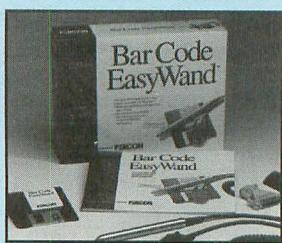
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## Barcode Wand

Peron's Bar Code

EasyWand package includes everything you need to begin scanning barcodes. The package includes a steel wand, decoding software, nine-to-25 pin adapter and a wand holder. The wand connects directly to the serial port of a desktop or portable PC. Decoding software loads



under DOS or Windows. Scanned information appears as keyboard-entered data to the existing software application. \$249. Peron, Inc., 1720 Willow Creek Circle, Ste. 530, Eugene, OR 97402; tel.: 800-929-7899; fax: 503-344-1399.

CIRCLE NO. 11 ON FREE CARD

## Cordless Printer Sharing

Merritt Computer Products' Cordless Printer Sharing Kit uses a radio-frequency transmitter and receiver to create a printer network. Each kit lets you connect one computer to one printer, though the technology has the capability to connect 16 computers to four different printers. A 900-MHz transmitter connects to the computer, and a receiver connects to the printer that can be located up to 100 feet away. \$239.95/\$119.95, Kit/Add-on. Merritt Computer Products, Inc., 5565 Red Bird Ctr. Dr., Ste. 150, Dallas, TX 75237; tel.: 800-627-7752; fax: 214-339-1313.

CIRCLE NO. 12 ON FREE CARD

## ISA SCSI-2 Controller Kit

The PLUGNPLAYSVP High



Performance SCSI-2 Plug and Play Controller Kit from Future Domain provides everything you need to add SCSI mass-storage or other peripherals to an ISA-bus PC. The controller automatically configures itself when used in a system that's equipped with a Plug and Play system BIOS. It can also perform automatic device ID configuration for SCSI devices that support the SCSI Configured Automatically specification.

The kit includes the 16-bit PNP-1630 SCSI-2 controller, an internal cable with built-in termination, PowerSCSI! Version 4.0 software and two CD-ROM applications. \$149. Future Domain, 2801 McGaw Ave., Irvine, CA 92714; tel.: 714-253-0400; fax: 714-253-0913.

CIRCLE NO. 14 ON FREE CARD

## Remote Control

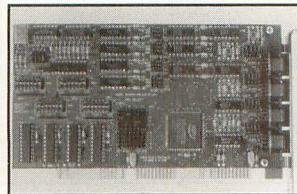
SoftMagic's PowerControl is a remote-control device for

computer/multimedia presentations. This hand-held, wireless remote lets you assign keystrokes, mouse commands or a special effect to any button on the remote to use with any Windows application. It also comes pre-programmed to control nine popular presentation software programs. *F/X Power Tools*, included in the package, lets you produce special effects in Windows programs. \$219.95. *SoftMagic Corp.*, 72 Mallard Way, Waltham, MA 02154; tel.: 617-899-9966; fax: 617-899-1458.

CIRCLE NO. 15 ON FREE CARD

## Four-Port Serial Card

B&B Electronics' Model 3PXCC4A serial card features four serial ports in a single slot. Each port can be independently configured for any I/O address and any IRQ, as well



as RS-232, RS-422 or RS-485 data protocol. Each port uses a buffered high-speed 16550A UART. The card uses eight-conductor RJ-45 connectors. \$209.95. *B&B Electronics*, 707 Dayton Rd., PO Box 1040, Ottawa, IL 61350; tel.: 815-434-0846; fax: 815-434-7094.

CIRCLE NO. 16 ON FREE CARD

## Parallel-Port EEPROM Programmers

Xeltek's ROM Master/1 and ROM Master/4 EEPROM programmers connect to the parallel port of a PC. ROM Master/1 is a 32-pin, single-socket programmer that supports 24-,

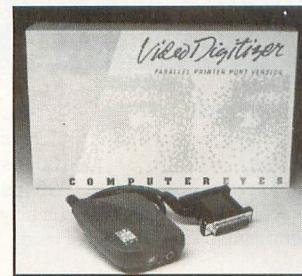


28- and 32-pin EPROMs, Flash EPROMs, serial EPROMs, GAL 16V8s and GAL 22V10s. ROM Master/4 is a 32-pin, four-socket gang programmer that programs four EEPROMs and Flash EPROMs using high-speed parallel programming. Software is included. \$199/\$279, 1/4. *Xeltek*, 757 N. Pastoria Ave., Sunnyvale, CA 94086; tel.: 408-524-1932; fax: 408-245-7084.

CIRCLE NO. 17 ON FREE CARD

## Parallel-Port Frame Grabber

Digital Vision's Computer-Eyes/LPT parallel-port video frame grabber features 24-bit



color capture through both composite and S-video inputs. The device is powered directly from the parallel port or from an internal battery. Included is Windows capture software, which supports all standard image formats, and a Twain driver. \$399.95. *Digital Vision, Inc.*, 270 Bridge St., Dedham, MA 02026; tel.: 617-329-5400; fax: 617-329-6286.

CIRCLE NO. 18 ON FREE CARD

## Rugged Notebook PC

The FC-486 from Husky Computers is an all-weather 486 notebook computer that's designed specifically for rugged use in the field. Its fully sealed magnesium-alloy case incorporates both screen and keyboard in a single hinge-less unit that weighs approximately 4 lb. The computer accepts both keyboard and pen entry.

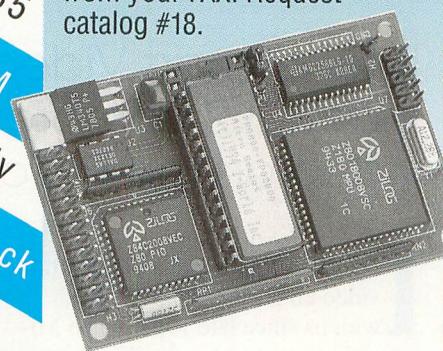
The FC-486 features a TI 80486SLC processor operating at 25 or 50 MHz, two fully sealed PCMCIA slots and two

(Continued on page 104)

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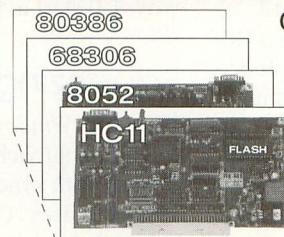
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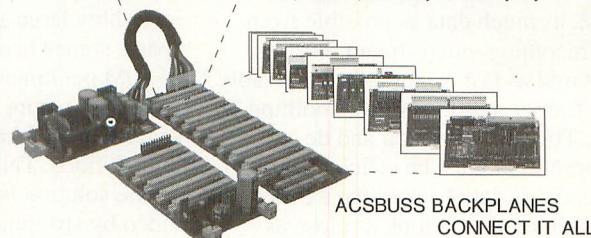
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# Digital Video—Now You Can Do It and View It On Your Desktop PC

Intel's Smart Video Recorder Pro capture card and Indeo 3.2 compressor make full-screen, full-motion video on the PC come of age

It's difficult to believe that digital video under *Windows* has been with us since late 1992, when Microsoft released *Video for Windows* 1.0 and the first video-capture cards for PCs hit the market. While it was certainly something new and novel at the time, *Video for Windows* (and Apple's *QuickTime for Windows*, which followed *VFW*'s release within a week) suffered from three main drawbacks: small image size (typically 160 X 120 pixels), slow capture and playback frame rates (15 fps maximum) and huge hard-disk storage requirements. Things have progressed continually since then, but it wasn't until Intel released its new Smart Video Recorder Pro capture card and new Indeo 3.2 compression algorithm that things took a quantum leap forward.

Intel has done something good with its new hardware and software compression—so good, in fact, that it's now possible to obtain 30-fps playback on a Pentium system and close to this on 486DX2/66 systems without a hardware decompression card to assist it.

To achieve such outstanding playback rates, two things are required. First, as much data as possible from the incoming video stream must be captured as fast as possible, preferably full-frames at 30 fps so that nothing is lost. Then compression and decompression must be efficient enough to feed this data back to the PC fast enough to make it look as close as possible, with regard to image clarity and fluidity of motion, to the way the original source footage looked. From

**Table 1. INDEO R3.2 PLAYBACK OPTIMIZATION ACCORDING TO CPU POWER**

Processor	Full-Screen	1/4-Screen	1/16-Screen
i486SX/25	1 fps*	15 fps	30 fps
i486DX2/66	10 fps	30 fps	30 fps
Pentium	20 fps	30 fps	30 fps

\*Fps indicates frames per second. Frame rates based on playing Indeo file captured at 30 fps. Rate may vary based on configuration and clip being used.

Indeo's scale-able technology automatically optimizes playback to match capabilities of hardware present in a PC system. Faster, more powerful CPUs result in enhanced playback rates.

an engineering point of view, this is one very tall order. To understand why, I'll start at the beginning.

## Squeezing Video Files

*Video for Windows* is Microsoft's proprietary approach to digitizing moving images with synchronized sound. This approach uses AVI (audio-video interleaving). Under this scheme, video material is interleaved with a corresponding audio soundtrack to produce synchronized video playback with sound.

Uncompressed video takes up an incredibly large amount of hard-drive space, somewhere in the neighborhood of 50M per minute. At this rate, it would take more than 1.5G of disk space to hold a half-hour's worth of digital video. This is clearly not viable.

The solution is to compress the video by stripping away unnecessary information to make each frame as compact as possible. Several compression algorithms have been developed

by numerous companies do this, including Microsoft's own Video 1, Intel's Indeo, SuperMatch's CinePak Codec and Intel's new Indeo R3.2. The last compressor, the latest and greatest from Intel, holds the most promise because it does real-time, on-the-fly compression at acceptable frame and data rates.

Because of its versatility and flexibility, digital video has several significant advantages over analog video. You can edit it, store it and transmit it easily. As I stated earlier, however, the process of digitizing video generates massive amounts of data that, in turn, creates a storage problem.

Intel's Indeo R3.2 compression algorithm reduces the size of uncompressed digital video files from 5 to more than 10 times. The "R" preceding the 3.2 stands for "real-time" because this algorithm works in concert with the Smart Video Recorder Pro card to capture and compress the video stream in real-time, eliminating the off-line compression step usually

required to optimize the size of captured video data.

The importance of compressing the data is underscored when you consider that the 50M/minute figure is for a very-small-screen video file. Storage requirements rise to well beyond 100M/minute if you increase the image size or frame rate. On average, Intel's Indeo R3.2 reduces the typical 50M of video data to about 9M.

Compression has other advantages besides conserving hard-disk space. Not only do compressed files require less storage space, they also process faster, which results in better-quality playback.

## A Better Mousetrap

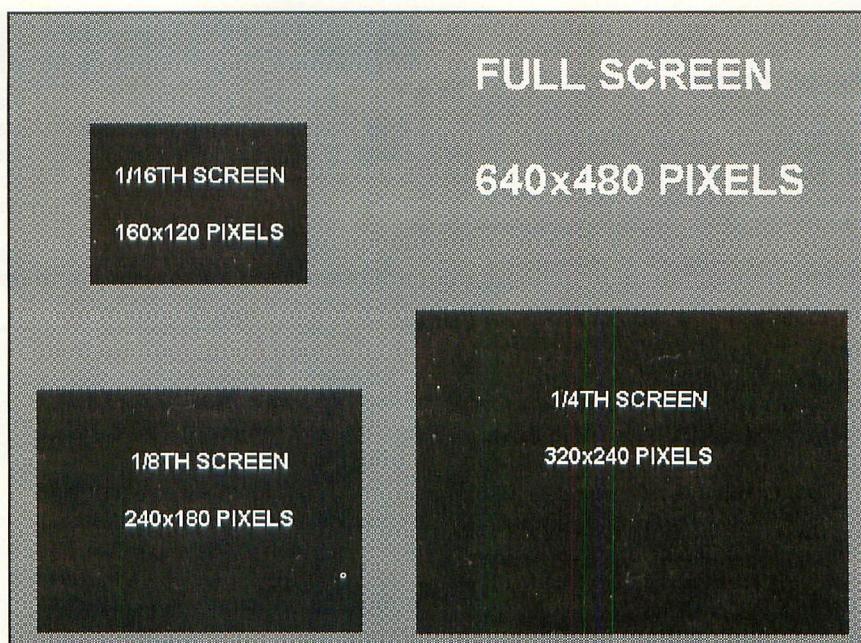
Intel's Indeo R3.2 approach has some features that make it significantly superior to competitive compression and playback technologies, not the least of which is the fact that it's included free in products like *Video for Windows*, IBM's OS/2 and Apple's *QuickTime* (for the Mac and *Windows*).

Indeo is a scale-able technology, which means that it automatically determines what hardware is available and optimizes playback for the detected configuration. For example, it gives faster frame rates to machines that have more processing power, as shown in Table 1.

It's important to bear in mind that full-screen video at 20 fps is an excellent achievement, especially when you consider that 8-mm home movie cameras typically shoot at 18 fps and films shown in movie theaters are shot and projected at 24 fps.

Since digital video playback requires lots of computing power to handle the flood of data streaming in at a very fast rate, DX2/66-, DX4- and Pentium-based CPUs provide the best platforms for such tasks. But other factors, such as smaller playback window sizes and slower frame rates, can produce acceptable results on even 25-MHz 486SX systems.

Essentially three factors affect video playback. These are microprocessor speed, playback window size and frame rate. Smaller playback windows result in smoother, more-natural video images. A faster microprocessor supports larger playback windows and greater frame rates. Systems built around DX2/66, DX4 and Pentium



**Fig. 1.** Relative sizes of standard video windows, with 320 x 240 currently being largest possible frame capture size. Indeo technology is scale-able, utilizing power of PC on which it's being run to optimize playback size. By running 320 x 240 clip from *Windows Media Player* accessory with full-screen box checked in configuration options, video fills display screen with image by multiplying each pixel by factor of 4.

CPUs provide the muscle and speed required for faster frame rates and larger playback windows.

To achieve best-quality playback, you must first capture as much video data as possible during the recording process. Currently, Indeo video per-

mits capture in a 320 X 240-pixel window at 15 frames per second with 24 bits of color. This is more than sufficient to ensure good quality when video is played back in larger windows (Fig. 1).

A unique feature of Indeo R3.2

**Table 2. Relationships of Quality Settings to Resulting Data-Storage Requirements**

Image Size	Compressed Minimum Quality	Compressed Maximum Quality	Raw Capture No Compression
<b>Approximate File Sizes @ 15 fps</b>			
160 x 120	4M/min.	8B/min.	21M/min.
240 x 180	8M/min.	15B/min.	45M/min.
320 x 240	12M/min.	24M/min.	77M/min.
<b>Approximate File Sizes @ 25 fps</b>			
160 x 120	7M/min.	13M/min.	34M/min.
240 x 180	13M/min.	25M/min.	74M/min.
320 x 240	19M/min.	40M/min.	132M/min.
<b>Approximate File Sizes @ 30 fps</b>			
160 x 120	8M/min.	16M/min.	41M/min.
240 x 180	15M/min.	29M/min.	89M/min.
320 x 240	23M/min.	48M/min.	154M/min.

Numbers are based on capturing 1 minute of high-quality video source material with audio set at eight-bit, mono, 11 kHz.

As these figures show, even highly-compressed .AVI video files require lots of memory. High-speed, large-capacity disk drives, fast CPUs and lots of RAM to enhance capture and playback of digital video.

technology is that it compresses video in real-time as it's being recorded through the video-capture card. This is known as on-line compression. Other capture cards typically save the raw video data to disk and compress it at a later time in a process known as off-line compression. Off-line captures require huge amounts of disk space, and the compression process can take up to 15 to 30 minutes per minute of video.

Intel's R3.2 algorithm employs multiple types of "lossy" and "lossless" compression techniques. With lossless compression, no information is lost, but it's encoded into a format that occupies less space. Lossy compression, on the other hand, carefully removes "excess" data from video images that won't be noticed by the human eye. Due to the smaller amount of data contained in each frame, this affords greater compression ratios and results in better playback performance.

The amount of compression applied to a video stream can be affected by two factors during capture: the video data rate and the desired-quality setting. Greater data rates result in more video information being captured. In turn, this results in larger file sizes. Similarly, higher-quality settings require additional capture data, which also increases file size. Table 2 illustrates the relationship of the quality settings to the resulting data-storage requirements.

Intel also gives the option of capturing raw (uncompressed) video. A raw-video capture stores more of the original video information, but it requires a truly humongous amount of storage space and a hard drive that's fast enough to keep up with data streams that can exceed 1M/second, depending on color depth, image size and frame rate. Both compressed and raw captures have their strengths and weaknesses (Table 3).

Most commercial software developers and providers of digital video clips capture video raw and compress it off-line because it generally yields better quality, even though it takes lots of time and additional hard-drive space to complete off-line compression. However, Intel has a new YVU9 "near-lossless" compression algorithm for the professional development community that will, for many, make raw captures a thing of the past since the quality

Table 3. Considerations in Choosing Video-Capture Formats

	Compressed Capture	Raw Capture
Pros	Smaller files Faster to capture	Best possible quality
Cons	Quality is lower than raw	Larger file sizes may drop frames because system can't keep up with large amounts of data

Intel's Indeo YVU9 "near-lossless" compression algorithm, currently available to only professional developers, gives all of the pros of raw and compressed formats, without any of the cons of either.

rivals that of raw capturing with off-line compression. But, like R3.2, it captures and compresses in real-time, saving time and hard-drive space.

The YVU9 compressor won't be available to the general consuming public, nor will it be included in any applications or products that currently provide the Indeo R3.2 compressor. It's a professional development tool only. My own experiences with YVU9 have been very satisfactory. In side-by-side video-clip comparisons I've done, I can't detect any perceptible difference in video quality between captures done using YVU9 and raw captures compressed off-line. In fact, all of the video clips on the CD-ROM that accompanies my book *Introduction To Desktop Video* were captured using the YVU9 algorithm and Intel's Smart Video Pro Recorder card.

As good as Intel's new R3.2 compression is, it isn't a stand-alone solution;

Indeo still requires the special hardware punch provided by the Intel Smart Video Recorder or new, faster Smart Video Recorder Pro card.

If you own one of the original Intel Smart Video Recorder cards, take heart, all isn't lost. The new Indeo R3.2 compressor algorithm also works with the older Smart Video Recorder, but you won't be able to capture larger image matrices at the higher frame rates supported by the new Smart Video Recorder Pro card, but you will be able to gain a significant improvement in capture quality and frame rates over the older Indeo 1.1 compressor or other compression algorithms you've been using with the original Smart Video Recorder. This backward compatibility with existing hardware is a very important point if you're thinking of buying a video-capture card.

Since Intel is constantly improving the performance of its video-capture

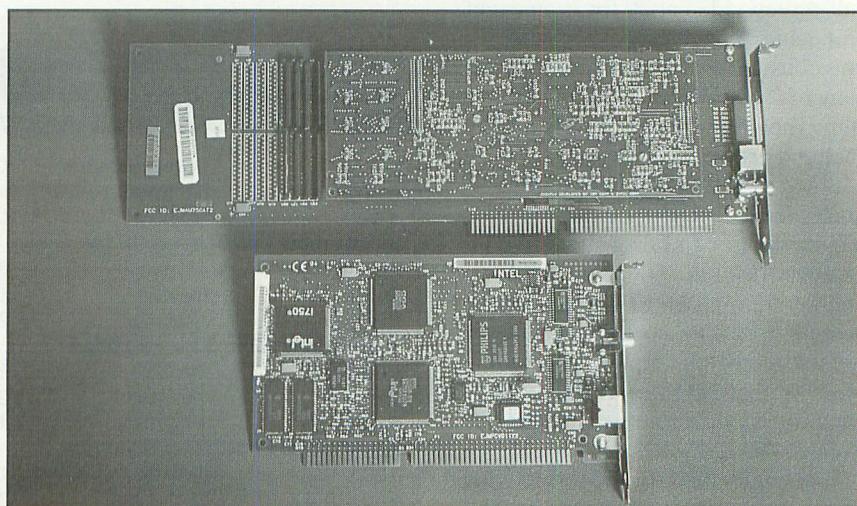
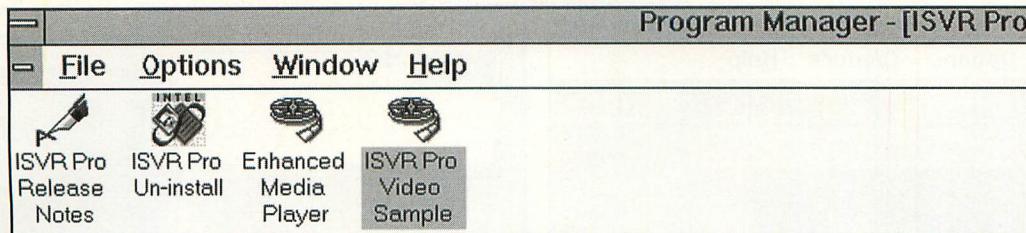


Fig 2. Original Intel Smart Video Recorder card (upper) and new smart Video Recorder Pro card (lower). Pro uses clock-doubled i750 video-processing CPU and makes extensive use of LSI and surface-mount technology. Result is much smaller card that's only half the size of original Smart Video Recorder, yet delivers twice the performance. Hardware DIP switches for selecting IRQ/port settings on older card have also been replaced by soft-selectable settings on Pro card, eliminating need for DIP switches on new version.

(Photo by Joe Abbato, The Photography Place)



**Fig. 3.** Icons installed by *Intel Smart Video Recorder Pro* software. Enhanced Media Player applet is really only one you'll probably ever use after installing card, but uninstall utility is provided for cleaning up *Windows* environment if you ever remove the card. The video sample clip is a good example of quality possible, even though the sample is in only 240 x 180 format. With Indeo scale-able technology, clip can fill screen by selecting proper configuration options in Enhanced Media Player (full-screen, zoom x2).

and compression algorithms (Indeo 4.0 is under development and should be available by the end of 1995), it's committed to making any new software advances compatible with its existing hardware base.

## Smart Video Recorder Pro

The excellent image sizes and capture rates now achievable wouldn't be possible without a fast capture card. This is where Intel's Smart Video Recorder Pro comes into play. This card still has an Intel I750 video-processing CPU as its heart. It utilizes a clock-doubled chip to deliver twice the capture speed and performance of the original Smart Video Recorder card.

The original Smart Video Recorder was a full-length card that had a daughterboard attached via nylon stand-offs and headers. In its original incarnation, Smart Video Recorder had lots of discrete components and a bank of DIP switches that was accessible via an opening in its mounting bracket for selecting IRQ and port address. Also on the bracket were jacks for composite-video and S-video input signals.

Smart Video Recorder Pro is only a half-length card (Fig. 2) that, at first glance, bears little resemblance to its predecessor. It makes extensive use of large-scale integration (LSI) and surface-mount components, and all IRQ/port settings are made via software. Therefore, the DIP switches are gone, but the mounting bracket still provides inputs for composite and S-video sources.

Like the original Smart Video Recorder, the Pro is a 16-bit card that requires installation in a 16- or 32-bit slot. Once the card is installed, the cover of the PC's system unit can be replaced because all other configura-

tion associated with installation is accomplished via software. Attaching a cable from an NTSC video source, like a camcorder or VCR, to the appropriate composite or S-video jack on the card's mounting bracket completes hardware installation.

Software supplied with Smart Video Recorder Pro consists of the *Intel Smart Video Recorder Pro* (two diskettes that contain video-capture and compression drivers) and Asymetrix's *Digital Video Producer* (three diskettes that contain video capture, editing and playback software). Also provided is a CD-ROM of Tri-Digital DigiClips consisting of an interesting assortment of video clips, music and animation sample files.

All of the software installs from *Windows*. Choosing the default values will work in the vast majority of situations, even on systems that have lots of other peripherals installed in them. *Digital Video Producer* must be installed first, followed by *ISVR* setup software. Since testing the hardware is one of the required steps to configure the system and complete software installation, you must have a video source attached and turned on to send a signal to the card.

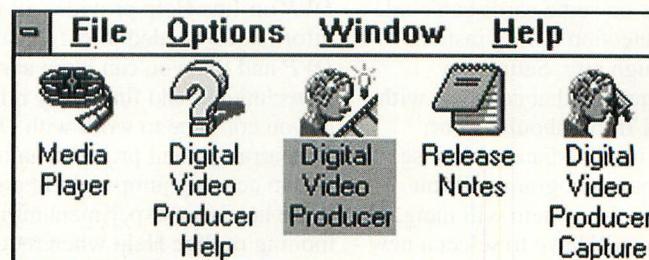
The software creates two program

groups, one for the *Intel Smart Video Recorder Pro* and the other for the *Asymetrix Digital Video Producer*. The *ISVR* group consists of four icons: one for the release notes *README* file, another for a video clip produced with the card, yet another for the included Enhanced Media Player applet and a final one for an uninstall utility (Fig. 3). The last icon is provided should you ever decide to remove the card and its attendant drivers.

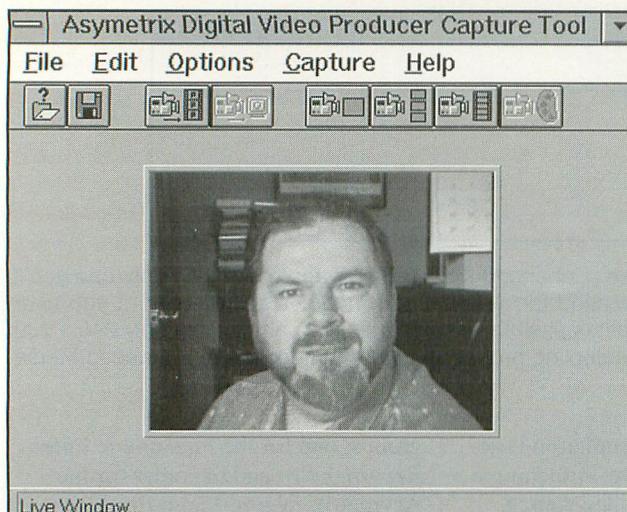
With the exception of the Enhanced Media Player applet for viewing clips and the possibility of using the uninstall utility, all of the action takes place from the *Asymetrix Digital Video Producer* group (Fig. 4).

The last installation procedures consist of turning on the video source (camcorder, VCR, laser disc), clicking on the *DVP Capture* icon in the *Asymetrix* group to launch the capture program and selecting Preview Mode from the Options menu. At this point, you should see an image of whatever is in front of the camcorder or is playing on the VCR or laser disc player (Fig. 5).

If you don't observe an image and you've checked the obvious items concerning your video source (lens cap off camcorder, tape in VCR, video



**Fig. 4.** Majority of action takes place from *Asymetrix Digital Video Producer* software group shown here. Icons are provided for initiating video capture and launching *Digital Video Producer* for editing, adding titles and more. Both Capture and Producer applications are extraordinarily rich in features, options and effects.



**Fig. 5.** Digital Video Capture application provides live preview window that confirms source video signal is feeding into Smart Video Recorder Pro card. Absence of clear, stable live window image after troubleshooting obvious possible problems with source and connections indicates an I/O address conflict that must be rectified.

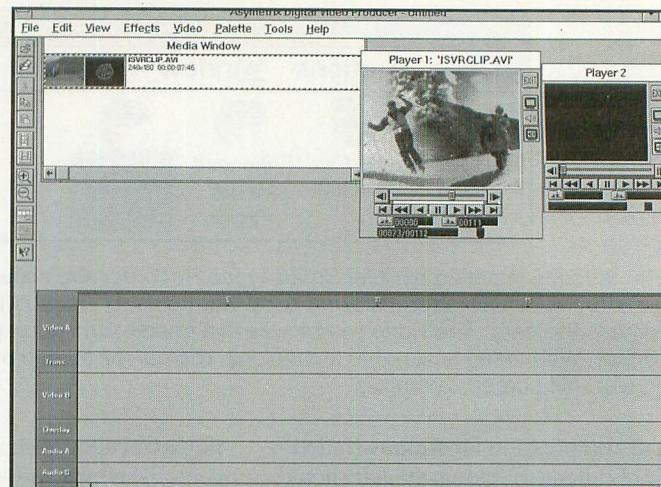
source turned on, etc.), there may be an I/O address conflict.

If you do observe an image in the live-preview window, all is well—so far. You should then click on the *DVP* icon in the Asymetrix group to open *Digital Video Producer*. From the file menu, select “import media” and highlight the sample video file supplied with *Smart Video Pro* (the default location for it is in c:\vispro\isvr-clip.avi). Drag the video image from the Media Window to the Player 1 window, and it should automatically start playing (Fig. 6).

If everything goes well, you’re ready to start doing your own captures and productions. If it doesn’t, you must resolve the I/O conflict before you can proceed further.

The Setup program normally detects which interrupts are being used and then chooses one that’s free. However, the interrupts on some cards can elude successful detection during installation. So, though rare, Setup may choose an interrupt that conflicts with another card. If this should occur, you’ll know it immediately because the *DVP* Capture program will run very slowly or the system will hang. If this occurs, you’ll have to select a new interrupt (Fig. 7).

You select a new interrupt value via the Control Panel in the Main program group by clicking on the *ISVR Pro* icon. A list of valid interrupt choices



**Fig. 6.** Proper operation of video playback is checked during installation importing sample video clip provided into media window of Asymetrix *Digital Video Producer* and dragging it to one of two player windows. Installation is successful if clip starts to play immediately.

and I/O addresses is presented, with the current selections highlighted. When other choices are made, clicking on the Run Diagnostics button checks the new settings for conflicts. Once the settings are resolved, you can start using the hardware and software.

### Digital Video Producer

*Digital Video Producer* is really two programs. *DVP Capture* is used to capture source video from a camera or VCR to a video file (.AVI file) on your hard disk. *DVP* is used to edit the video file and add special effects.

What surprised me somewhat was that no manual was supplied with the *DVP* software, although a concise but thorough Installation Guide and Video Tips manual was provided for the Intel Smart Video Recorder Pro. A card provided in the package advises that *DVP* on-line Help provides all the information needed to get started with *DVP* and that you can learn about video techniques and find ready reference as you continue to work with *DVP*. This arrangement provides an incentive to actually jump right in and do some hands-on experimentation, summoning on-line Help when required.

I soon realized the reason for this arrangement. The *DVP* software is so intuitive and straightforward that the need for a printed manual just doesn’t exist. On-line Help also has an “al-

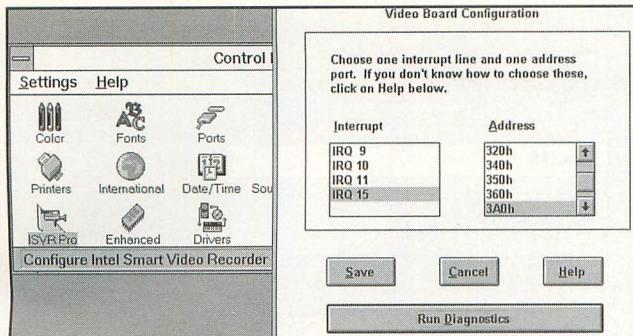
ways on top” option to keep it accessible while you’re working in *DVP*. Once you gain some experience with the program, you’ll find your need to refer to the Help screen is very infrequent (Fig. 8).

### Doing a Capture

Although you can work with the included sample .AVI files on the Tri-Digital DigiClips CD-ROM, the essence, purpose and real fun of the Smart Video Recorder Pro package is to digitize your own video material. This starts with doing a capture.

To start the capture process, you click on the *DVP Capture* icon in the *DVP* group to launch the application. Before you start capturing, you should name your video file and allocate space for it. You name the file from the File menu by selecting Set Capture File and giving it a name (up to eight characters), followed by the extension .AVI. Next, allocate space for the file, which you do by selecting Allocate File Space, also from the file menu.

The Set File Size window shows the amount of free disk space available and arbitrarily assigns a value for the capture file size (the program assigned 11M as the size in Fig. 9 before I changed it to 1M). I recommend changing the value to 1M, regardless of how much space you think the video file may actually require because if



**Fig. 7.** If changing interrupt setting is required, this is easily accomplished via ISVR Pro icon in Control Panel. A listing of valid interrupt and I/O address choices is presented, along with diagnostic utility to check for conflicts with any selected settings. Current settings are highlighted.

**Fig. 8.** DVP on-line help provides all information you need to use capture and editing facilities of software. Both Capture and Producer programs are so intuitive and straightforward that summoning up on-line Help utility will rarely be required for most users.

you enter a larger number (for example, 30M) but your video is short and actually requires only 3M, your file will still occupy 30M on your hard disk. On the other hand, if you allocate 1M, *DVP* will dynamically allocate more disk space as you continue to capture. So setting a file size of 1M doesn't limit your file to 1M. *DVP* will keep writing to your disk for as long as you record, and your file will be the same size as the amount of video data you actually capture (Fig. 10).

Next, choose the Video Format selection from the Options menu to specify the video compression method and size for the video window. You'll also select a desired video data rate or a quality setting (the default is quality). Video data rate is selectable from 80K to 300K B/second and determines how much video data is sent to your disk each second. A lower data rate yields a smaller file, but it also yields lower video quality. The quality setting is selectable from 1% to 100% and sets a minimum data rate that's maintained for the video quality setting you choose. A high setting yields best quality video, but the resulting files are larger. A low setting creates a smaller file, but video quality is reduced.

It's important to note that you may not always obtain the exact data rate you choose. The resulting data rate depends on how much motion and color is in your video, the quality of your video source and frame rate. Usually,

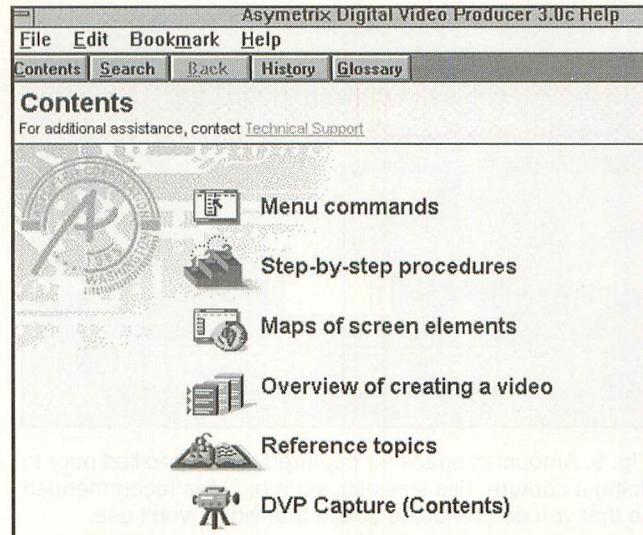
however, you get a higher data rate than you choose. The exception here is a low-motion black-and-white video clip that will result in a lower data rate (Fig. 11).

You must also select the video source to tell Smart Video Recorder Pro which (composite or S-Video) to expect the video signal to come in from. You can save this setting if you'll always be using the same port, which permits you to skip this step for subsequent capture sessions (Fig. 12).

Defining the capture settings completes the required setup prior to initiating a capture. Choosing a frame rate is the first order of business. The frame rate measures how many frames are captured per second and is selectable from 1 to 30 fps. A high frame rate produces a smoother video, but the resulting file sizes are larger.

The following general frame-rate guidelines are good ones to follow: High-motion video (sports, action sequences) should be at 15 to 30 fps; limited-motion Video should be at 10 to 12 fps; and talking heads should be at 10 to 12 fps.

If you've checked the Capture Audio box, you may also want to adjust your audio-capture settings using the Audio Format selection available in the Options menu. As a general rule of thumb, the following settings will yield good results: talking heads—eight-bit, mono, 11 kHz; and Music—eight- or 16-bit, mono, 22 kHz. As with video, higher quality settings for the audio (for



example, 16-bit, stereo, 44 kHz) increase the final .AVI file size.

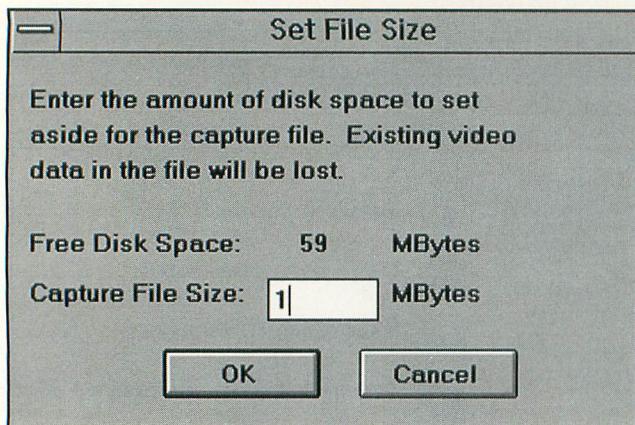
With all choices made, you're ready to perform a capture. From the capture menu, select either Frames or Video. Selecting Frames captures one frame at a time (single-frame captures can be up to 640 X 480 pixels), while selecting Video initiates a motion-video capture. Capture begins as soon as you click on either choice.

Capture terminates when you press the Esc key (or space bar, F8, etc., if you chose one of those in the Capture Settings dialog). If you click on Enable Capture Time Limit in the Capture Settings dialog and you don't press Esc, the capture terminates when the preset amount of time is up.

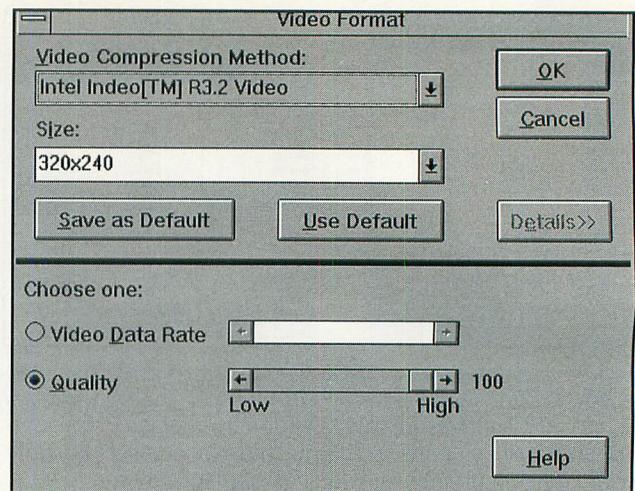
The foregoing is all there is to making a capture. If you've used the Indeo R3.2 compressor during a capture, your .AVI file is ready for immediate playback.

If you've captured raw video, you'll want to compress it at this point. You can do this by opening the *DVP* application and choosing Import Media from the file menu. Once imported, you drag the media onto the timeline and choose the compression desired from the dialog box. You can also re-compress a file that has already been compressed, but you may notice some degradation in quality (Fig. 13).

The defaults for the compression quality settings, key frame frequency and data rate are the best choices for most clips and deliver very pleasing



**Fig. 9.** Amount of space for captured file is specified prior to doing a capture. File size allocation of 1M is recommended so that you don't allocate space that video won't use.



**Fig. 10.** Video Format screen gives choice of capturing and compressing "on the fly" via Indeo 3.2 compressor or capturing raw video data for off-line compression at a later time. You also specify desired video window size (160 x 120, 240 x 180 or 320 x 240) and specify either video data rate or quality setting desired for captured segment.

results. The process of off-line compression is very time-consuming, however. For example, a 30-second video may take 30 minutes or more to compress, depending on video file and processor speed.

A compressed file (whether compressed during capture or done off-line) can now be played back using *DVP* or the Media Player. It's very important to note that no hardware is required to play video files. You just need to install the *Video for Windows* runtime files (provided on one of the *DVP* diskettes) on any 486- or Pentium-based system.

While playing back simple captures is fun and rewarding, with the *Digital Video Producer* software, you can get really creative by editing your captures, adding titles, combining multiple video clips using an assortment of transition effects, mixing audio tracks and more to produce truly professional-quality digital-video productions.

As with any film or video project, the raw footage is transformed into a finished presentation during the editing and post-production phases. *Digital Video Producer* provides all the tools you need to polish and transform digital-video productions (Fig. 14).

## Using DVP

*Digital Video Producer* uses the "project" concept to pull together the elements needed for a finished video pro-

duction. You can save project files (they use a .PRJ extension) for additional modification at a later time or to use as the basis for variations of the same elements. The procedures for creating a project are fairly simple and follow a logical order. They're as follows:

- **Select media files and add them to the project.** After starting *DVP*, you begin a project by locating and importing media files, which can be video, audio or bitmap files and can be in a number of file formats. You can import video from two types of sources: your hard disk or CD-ROM. Alternatively, you can use *DVP* Capture to capture video from a source like a VCR or videodisc and then import the captured video into your project.

You import media using the Import Media command on the File menu. When you import a media file, *DVP* adds the file to the Media Window, where it displays the media files you'll use in your project. Although a file in the Media Window is associated with your project, it doesn't become part of your video until you drag it onto the timeline.

- **Preview and mark a clip.** You can preview a clip and mark the section you want to use in your video by dragging a clip from the Media Window into either of the two Players. You can then preview the clip—whether a video, animation, bitmap or audio file—and mark the beginning and end-

ing points of the segment you want to use in your video.

- **Position media on the timeline.**

After you've used the Player to mark the segment of a media file you want to use in your video, you're ready to add the marked segment to the timeline. You do this by dragging the segment from the Player to the timeline. Once a clip is on the timeline, you can move it, delete it and preview it. You can also add transitions and other effects, titles and other overlays and other video, audio and bitmap media.

- **Add special effects.** Once a media clip is on the timeline, you can modify it in several ways, such as applying one or more filters to a single video track to create simple video effects like fade-ins and fade-outs or more-specialized effects like color inversion or ripples.

You can also control how media on each of the two audio and video tracks interact in the video by modifying the transition between them. For audio tracks, you can choose whether or not to cross-fade as one track ends and the next begins. For video, you can choose from a list of transition effects, many of which you can customize, to control how one video clip ends as the next begins. Finally, you can easily add titles and other overlay tracks and specify key colors. You can also control how titles and other overlays move, zoom or rotate in the video.

- **Adjust color palettes.** Getting ac-

(Continued on page 94)

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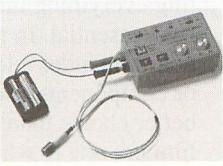
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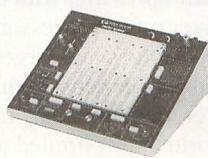
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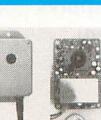
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# Tiny and Inexpensive Programmable Controllers for Quick Project Development

A microcontroller buying guide for 11 selected products in the PIC, 8051 and 68HC11 families

It's common knowledge that personal computers are constantly improving, with advances like faster microprocessors, larger and better displays and larger-capacity, faster and less-expensive disk storage. However, developments in the computer world aren't limited to personal computers. You can also find advances in the world of embedded controllers, the invisible computers that control car engines, cameras, household appliances, video and sound systems, computer peripherals, data loggers and all kinds of devices that have computer intelligence inside them.

In absolute numbers, the largest market for embedded controllers is consumer items like cars and video equipment, but small controllers also find homes in many projects in which you might need just one, two or maybe a dozen controllers. For example, you might want to design a process controller for a small brewing system, a data logger for scientific experiments or a security system that monitors and controls access to a specific area.

An easy way to get going on a controller project is to buy an assembled and tested circuit-board assembly or module that has the basic system components and the ability to act as a development system for testing the programming and hardware that you add. To the basic circuits, you can add whatever switches, displays, sensors and other I/O devices your project requires. The development system typically includes an easy way to load

your control program into memory for testing and debugging purposes.

When everything is working and your program is stored in permanent memory, the project is ready for use. Another approach is to use the module as a prototype for only basic testing of your circuits and programs. From here, you can develop your product with a circuit board of your own design.

Another use for these controller units is in education, using them as tools for learning about microcontrollers and computers in general. Having the basic circuits on a working board gives you a head start, and most boards are designed to permit easy experimenting.

In this article, I look at products from 11 vendors. Each includes a circuit board with a microcontroller, or single-chip computer, and ports for connecting sensors, switches, displays and whatever I/O circuits a project requires. In addition, all have the following features:

**Small Size.** Each of the boards and modules I looked at is physically small, ranging from less than a square inch to just under 13 square inches in area. The smallest boards use surface-mount components, which are much more compact than their through-hole (DIP) equivalents.

I used physical size as a general, if somewhat arbitrary, way to limit the selection of products to review here. Smaller boards tend to have simpler designs, though some do squeeze an

extraordinary amount into a limited area. Of course, for many projects, fitting everything into a small package isn't essential. In particular, if a larger board includes a lot of the interfaces or components you need, it may be a better choice than a smaller, more limited, one to which you have to add everything yourself.

**Easy Program Storage.** All of the controllers I looked at store their programs and data in EEPROM, Flash EPROM or battery-backed RAM. With all of these, you don't have to remove any chips or wait for ultraviolet (UV) erasure to store a program.

With some of the boards discussed here, you upload an assembled or compiled program from a personal computer into memory on the controller board. Others use an interpreted programming language that lets you store and run programs without having to first assemble or compile them.

All of the boards communicate with a personal computer via either a serial or parallel port.

**Low Cost.** Because these controllers are simple in design, they tend to be inexpensive. Prices for a complete development system, including most of what you need to get a project up and running, range from \$55 to \$250. Once you invest in the development system, the price of additional controller modules ranges from \$29 to \$120.

To use these products, you need a personal computer that has an avail-

able serial or parallel port. You may also have to provide one or more of the following: serial or parallel-port cable, power supply and assembler or compiler software.

## Limits

The simple design and low cost of these controllers means that there are limits to what they can do, in particular in the areas of capacity, speed and debugging tools.

**Capacity.** If your program is large, or if you need a lot of I/O or special features, these small controllers may not have what you need. Many eight-bit controllers can access 64 or even 128K of external memory, but most of the products reviewed here are intended for simpler projects and access smaller amounts of memory.

Some of the controllers don't use external memory at all. Instead, they store their programs and data entirely on the microcontroller chip. Others employ a serial EEPROM or another simplified memory interface.

**Execution Speed.** All of the boards discussed here use eight-bit chips. That is, their CPUs process data just eight bits at a time, as compared to the 16, 32 or more bits that other computer chips can handle. This limitation, plus slower clock speeds and possibly the limits of the programming language you use, means that these controllers aren't the fastest computers around, but they're still a good choice for many projects.

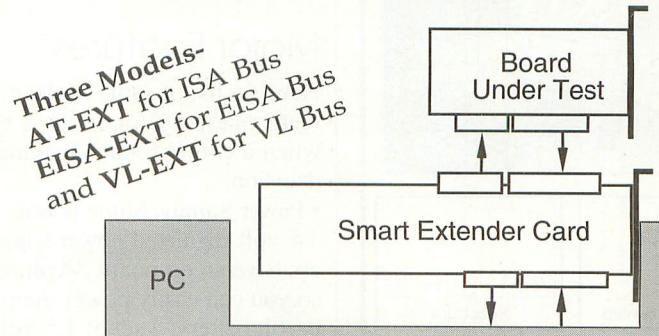
**Debugging.** If you're used to programming on a personal computer with a full set of debugging tools like those provided by *Codeview* or *Quick-BASIC*, these simple controllers will seem primitive by comparison. With some controllers, all you get is the ability to load programs into memory and run them. If you want debugging features, you have to write them into the code yourself. Controllers that have on-board BASIC or Forth interpreters add some tools, such as the ability to set breakpoints, view or change memory locations or variables and easily add or delete program lines.

**Learning Curve.** Finally, all of the boards discussed require some investment of your time in learning how to use them. The learning process includes becoming familiar with the

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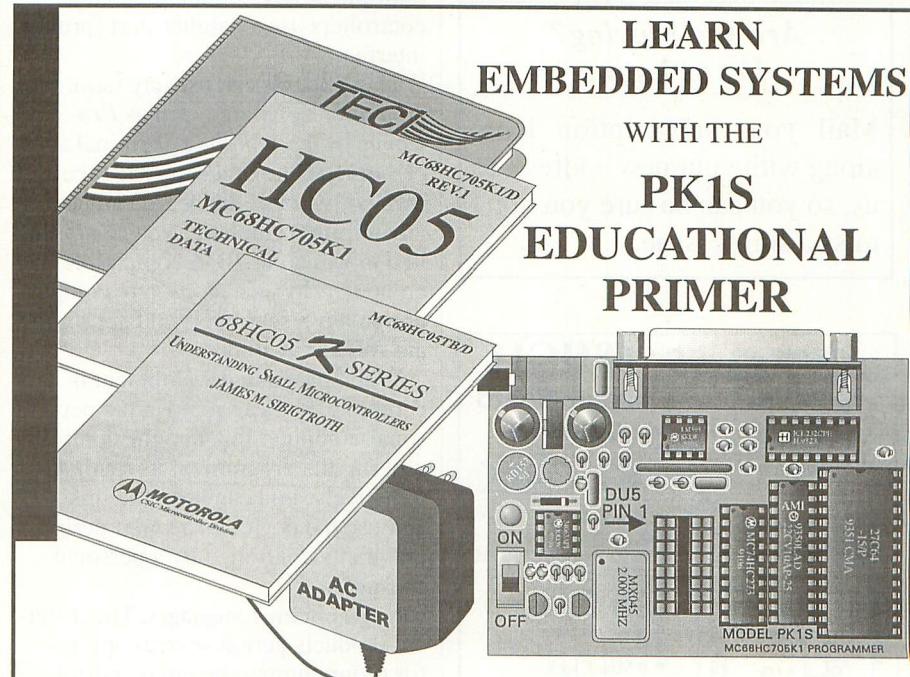
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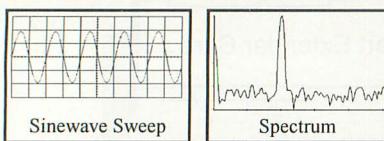
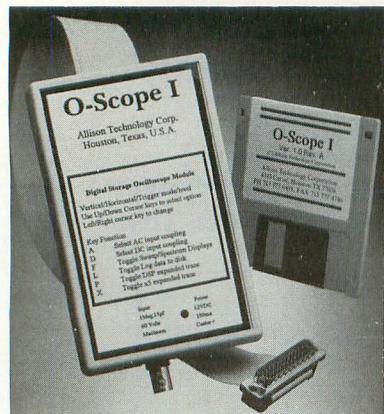
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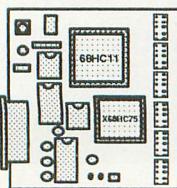
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programming language, circuits and communications software. If you have experience with any of these areas, so much the better. If not, good documentation can help a lot in speeding things along.

Almost all of the documentation I looked at included complete schematic diagrams. Beyond this, the amount and quality of support material varied over a wide range. My reviews include comments on the documentation.

### Major Features

Here's a list of some of the major features to look for on these boards when it comes time to making a buy decision:

- **Power Supply.** Some boards require a 5-volt regulated power supply. Others have an on-board 5-volt regulator so you can easily power them with a 9-volt battery, a set of 1.5-volt cells or a wall-type transformer supply.
- **PC Interface.** An RS-232 serial interface is the most popular way to communicate with these controllers. A few boards permit an RS-422 or RS-485 serial link, which can use cables up to 4,000 feet in length and permit multiple devices on the link. Other controllers use a parallel-port (printer) interface.

Some boards can use any terminal-emulation software (such as *Pro-Comm* or the *Windows* Terminal accessory), while others provide their own software. If the board can use any terminal emulator, you're not limited to using an "IBM-compatible" computer. In such cases, any computer that has a serial port and appropriate software will do.

When program development is complete, you can remove the personal-computer link and the controller will run the program on its own. Alternatively, you can keep the link and use the device as a smart peripheral that's controlled by a personal computer.

- **Programming Languages.** The different products permit several options for programming the microcontrollers. Some have an on-board BASIC or Forth interpreter, which enables you to execute commands and write programs "on-the-fly." This is especially convenient for simpler programs in which execution speed isn't critical.

Another option is to write programs in assembly language. Assembler software creates an object file from your source code. You then upload the object file to the microcontroller board's memory, using your communication software and supporting firmware on the microcontroller board.

If you have a C, BASIC or other compiler for your microcontroller, you can use it instead of an assembler. Some interpreters let you combine languages by calling assembly-language routines or permitting in-line assembly code. Most assemblers for the 8051 create object files in Intel Hex format, while 68HC11 assemblers use Motorola's S-record format.

- **Program Storage.** The options for program storage are EEPROM, Flash EEPROM and battery-backed or non-volatile RAM. Battery-backed RAM is fast and offers an unlimited number of erase/write cycles. The battery may be built into the device or located external to it, with a typical guaranteed back-up of 10 years.

EEPROM and Flash EEPROM require no battery, but they have a limited number of guaranteed erase/write cycles, ranging from 1,000 to 100,000. This should be enough for program code, but for constantly changing data (in a data logger, for example), you'll want to use battery-backed RAM or possibly high-endurance EEPROM. EEPROM and Flash EEPROM require more programming time than RAM, but this isn't critical for occasional program storing.

- **Peripheral Interfaces.** All of the products cited here have input and output (I/O) pins that enable you to connect such devices as displays, switches and analog-to-digital (A/D) and digital-to-analog (D/A) converters. Most also have hardware-interrupt inputs for fast response to external events.

Some products have additional I/O features that are either built into the microcontroller or are added on the board. Analog inputs, which make it easy to measure voltages, are a popular addition.

Built-in timers can make it easy to create a signal with a particular frequency or period or to measure frequency or period at an input. Some of the programming languages have a pulse-width-modulated (PWM) instruction that uses a timer to output a

waveform with selectable high and low times and number of cycles. A real-time clock is a special timer that keeps track of hours, minutes and seconds and sometimes days, months and years as well.

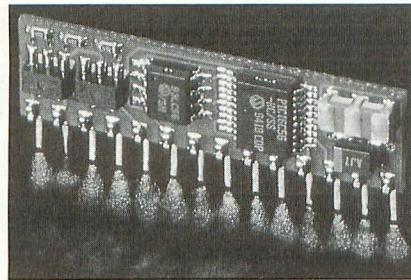
A couple of products have built-in support for an I<sup>2</sup>C bus, which permits the controller to access up to 128 devices using a synchronous serial interface. In these products, each device on the bus has a unique address.

## The Products

Although many users have strong opinions about which chip or programming language is best, I made no assumptions in these areas. The selection includes products with microcontrollers from three families: Microchip's PIC, Intel's (and others') 8051 and Motorola's 68HC11, with the ability to use a variety of programming languages.

### PIC Family

The PIC microcontroller has become popular in part because it's inexpensive, widely available and fast. One limitation to PICs is that on-chip program memory is available only as UV-erasable or one-time-programmable EPROM. However, there's one PIC product that permits easy storage of user programs.



#### Parallax BASIC Stamp

Parallax's \$39 BASIC Stamp is designed for getting simple projects up and running quickly. It's on a board that measures just 1 1/2" x 2 1/2" with a BASIC interpreter in the ROM of a 16C56 PIC microcontroller. User programs are stored in a 256-byte 93LC56 serial EEPROM.

The Stamp has just eight I/O pins, limited program and data storage and no hardware interrupts. Still, for simpler projects it's difficult to beat in terms of price and ease of use.

The new \$29 BASIC Stamp I Module is even tinier and less expensive, measuring just 0.4" x 1.4" in a SIP (single in-line

### On-line Resources

One of the best resources for learning about microcontrollers is the FAQs (compilations of frequently asked questions) that you can find on the Internet. Each includes basic information, plus extensive lists of related books, magazines, on-line resources, hardware and software relating to a particular microcontroller or microcontrollers in general. FAQs are posted periodically to a variety of newsgroups and are also available for FTP from archive sites. You might also find them on some BBSes. There are FAQs on these topics:

PIC microcontrollers  
8051 microcontrollers  
68HC11 microcontrollers  
Microcontroller primer

Look for the FAQs in the following newsgroups:

comp.realtime  
comp.robots  
sci.electronics

Another source is the archive site rtfm.mit.edu (plus all mirror sites):

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/pub/usenet/sci.answers/microcontroller-faq/8051 (or /68hc11 or /primer)  
/pub/usenet/news.answers/microcontroller-faq/8051 (or /68hc11 or /primer)

Yet another on-line resource is Motorola's BBS (tel.: 512-891-3733), which is now available on the Internet as freeware aus.sps.mot.com

package). It has all of the features of the BASIC Stamp, except for a prototyping area and battery clips. For easy experimenting, you can plug the Stamp I Module into a breadboard. You can also use your own printed-circuit board or Parallax's \$10 carrier board that adds battery clips, a reset button and a prototyping area that's actually larger than the BASIC Stamp's, all on a board that's the same size as the Stamp's.

Another new product, which may be available by the time you read this, is the BASIC Stamp II Module in a 24-pin DIP with expanded I/O and EEPROM and serial interface.

To program the Stamp, you also need the \$99 Programming Package that includes communications and editing software, a cable and documentation. The user manual includes a short example for each of the BASIC instructions, as well as a guide to using the software to write, load and run your programs. You also get a set of 19 application notes, with schematics, explanations and program code.

To use the Stamp, you connect a power supply or battery to it, plug the provided cable into a header on the BASIC Stamp board and a personal computer's parallel port and run the provided software. You're then ready to start writing and running programs.

The Stamp's BASIC language includes 46 instructions and operators, with some

that are especially handy in monitoring and control programs. BUTTON is useful for monitoring a manual switch, with automatic debouncing and branching when the input is in a desired state. POT reads a potentiometer or other variable resistance using a resistor/capacitor time constant. PULSIN measures frequency at an input, and PULSOUT generates a frequency at an output. Other instructions allow you to set, clear, toggle and read I/O bits.

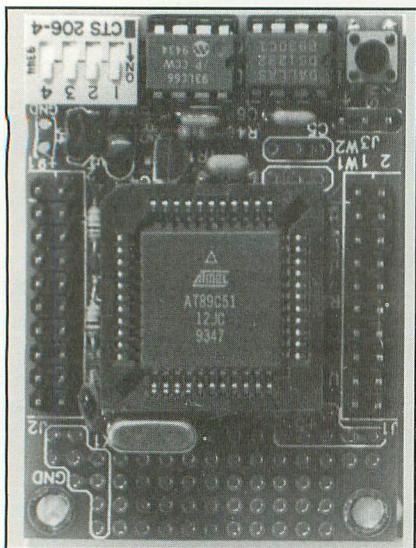
One nice feature of the Stamp's software is automatic detection of which parallel port you're using. This means that there's no need to remember or figure out the port address or whether you're using LPT1, LPT2 or LPT3. Another useful item appears when you load a BASIC program into the Stamp's EEPROM. An on-screen bargraph shows you how much of the EEPROM's capacity you're using. So you get immediate feedback about how much memory a program uses and a warning when you're nearing the limit.

Related products from Parallax include a serial LCD module, a Stamp Stretcher module with more I/O and an experiment board.

### 8051 Family

Intel's 8051 microcontroller family includes a wide variety of chips from many manufacturers. Some of the products I looked at use one of the

newer devices, while others stick with classic chips like the 8031.



### Allen Systems Little Byte-51

With Allen Systems' \$49/\$59 Little Byte-51/52, you get an 8051-compatible microcontroller, 4K or 8K of Flash EPROM for program storage, 512 bytes of serial EEPROM, a watchdog timer/power-supply monitor and a small prototyping area on a board that measures 3.7 sq. in. in area.

The microcontroller is Atmel's AT-89C51. You program the Flash memory by connecting two ribbon cables from Little Byte's headers to a \$99 PB-51/11 Programmer Board and setting DIP switches to put Little Byte into programming mode. When you're not programming, you can cable Little Byte's headers to your own I/O circuits.

The Programmer Board also connects to a personal computer's parallel port. The included software enables you to program a file in binary, Intel Hex or S-record format into the 89C51's Flash memory.

You can configure the Flash memory to use either a 12- or 5-volt programming potential. The Programmer Board lets you choose either option. Since it generates the 12-volt supply on-board, it makes sense to use 12-volt mode.

The Programmer Board also doubles as a general-purpose device programmer. It has solder pads for 28- and 40-pin DIPs and 44- and 52-pin PLCCs. If you install chip sockets (or buy a version with sockets already installed), you can use the board to program 87C5X, 89C5X, 68HC-711E9 and 27C256 chips.

Since the Programmer Board uses the parallel port's data lines for both sending and receiving data, a bidirectional parallel port is recommended. (You may have to first configure the port for "PS/2 mode" in your computer's CMOS setup).

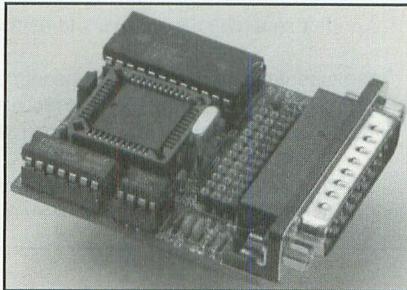
Traditional ports that aren't bidirectional

may or may not work with this board. I was able to use an older port with LSTTL chips, but two other parallel ports couldn't read data from the board. You might not want to risk using a port that isn't bidirectional in this way.

The documentation is complete, with data sheets for the ICs on the Little Byte board and explanations of the operation of the components. My Programmer Board's software came on a 5 1/4" disk, so be sure to request a 3 1/2" disk when you place your order if you need this size.

The data sheets specify that the Flash memory can endure at least 1,000 erase/write cycles, while the 93LC66 EEPROM is good for at least 100,000 cycles.

The specifications list 12- and 20-MHz versions of Little Byte for the same price. If my board was typical, the 12-MHz version actually operates at 11.059 MHz.



### Blue Earth Xplor-32

The \$59.95 Xplor-32 from Blue Earth is the base model of a series of controllers that run the company's TB52 BASIC interpreter on an 80C32. A \$99.95 starter package includes an Xplor-32, user manual and applications disk, serial cable, power supply and an interface module with a serial connector, screw-type terminals for I/O, power supply jack and X-10 connector. Alternatively, you can buy just the components you need from the package.

On the base model, you can access the I/O lines via a patch area, which is similar to a solderless breadboard and makes it easy to connect jumper wires and components to the ports. You can also jumper the I/O lines to a subminiature D-shell connector that plugs directly into the interface module.

The BASIC interpreter has 39 commands, functions and operators. BIT enables you to set, clear and read individual bits in internal data memory, including I/O ports. FREQ measures input frequencies up to 56.5 kHz. For controlling lighting and other devices, there's a built-in routine that automatically sends X-10 codes using the house and unit codes your program specifies.

XPLOR uses a Xicor X88C64 EEPROM to store the BASIC interpreter (4K) and user programs (4K). The EEPROM connects directly to the 80C32's

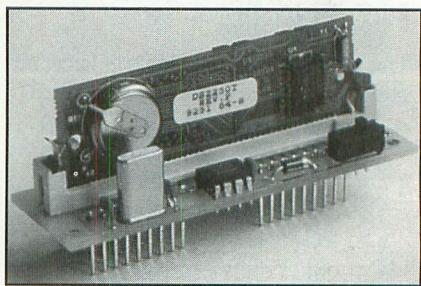
data/address bus via AD0 through AD7 and A8 through A13. Line A13 acts as the chip-select, and the EEPROM latches the lower address byte. Hence, there's no need for an external address latch. A block-protect feature of the EEPROM prevents you from overwriting the BASIC interpreter.

You communicate with the board over a serial interface, using your own terminal-emulation software. The manual includes instructions for using *ProComm* and the *Windows Terminal* accessory, but you can use any software you prefer.

The documentation includes detailed explanations of each of the BASIC instructions. The BASIC interpreter's source code is also available, if you want to build on or customize the language.

The \$79.95 -32a version includes an 11-channel, 10-bit A/D converter. The \$79.95 -32d adds 24 I/O lines to the standard 12. The \$89.95 -32c has screw-type terminals for the I/O connections, a power-supply jack, a serial-port connector and an enclosure.

Blue Earth also sells a variety of related products, including sensors and programming tools.



### EE Systems DSPlug

Dallas Semiconductor's DS2250T contains almost all of the elements of an 8051-compatible controller mounted on a 40-pin SIMM. EE Systems' \$120 DSPlug includes a DS2250T, along with a circuit board that has a socket for the SIMM, RS-232 interface, crystal, program/run switch, serial-interface header and cable and Wire Wrap pins for I/O access.

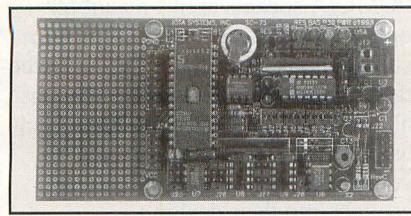
The DS2250T has 32K of battery-backed RAM you can use for storing programs and data. The amount reserved for each is adjustable by programming a partition on the chip. The RAM is separate from the microcontroller chip (a Dallas DS5000FP), but it uses a special bus interface that leaves all four I/O ports available for other uses. There's also a DS1214 real-time clock that stores time and calendar information.

The chip has a program-load mode that accepts Intel Hex files over a serial link and stores them in program memory. DSPlug comes with Dallas' KIT5K software on-disk, which enables you to use the bootstrap loader to store a program in RAM.

Other functions of the software include setting the data/program partition, reading RAM into a file, listing RAM contents in debug format, viewing and changing bytes in RAM and enabling security features. The user interface of the Dallas software isn't too elegant. If you type something it doesn't understand, the response is a rude "huh?"

Documentation for DSBlock is on-disk. You don't get a schematic, just a list of the functions for the Wire Wrap pins and serial connector. The DSPlug board is simple enough that you really don't need a schematic, but it would be handy to have a pinout of the board's DS1275 RS-232 transceiver chip. The disk includes some information about the DS2250, but you'll want to get Dallas' databook for the complete story.

You also get an example program and instructions for loading it into the DS2250 and a freeware version of PseudoCorp's 8051 assembler.



### Iota Systems SC-75

Iota's SC-75 uses Signetics/Philips' 87C752 8052-compatible microcontroller that has five analog inputs, a pulse-width-modulated output and built-in support for an I<sup>2</sup>C bus.

Several configurations of the board are available. For \$109, you get an on-chip BASIC-752 programming language, an I<sup>2</sup>C bus with 8K of EEPROM, 21 I/O pins, clock functions, a keypad, LCD module and other peripherals on a serial interface.

The EEPROM is Microchip's 24C65, which includes 512 bytes of ultra-high-endurance memory that can withstand 1-million erase/write cycles. The remaining 7.5K is rated at 10,000 cycles.

The board comes with four eight-pin I<sup>2</sup>C sockets. The EEPROM and clock chip each use one of these. You can add other components in the 2 1/2" X 1 1/2" prototyping area, or you can daisy-chain additional I<sup>2</sup>C interfaces on the provided cable.

To write and store programs on the board, you need additional hardware and software, all available from Iota. The \$250 SC-75 BASIC-752 package includes an SC-75 board with 8K of EEPROM, an I<sup>2</sup>C-bus-to-parallel adapter, I<sup>2</sup>C-bus ribbon cable, clock chip and development software.

The adapter enables the SC-75 to communicate with a personal computer. It connects to the SC-75's I<sup>2</sup>C bus and to the

parallel port of a personal computer. You also need a 25-pin male-to-female DB-25 cable to connect to the parallel port. (A nine-conductor serial cable won't do.)

The BASIC-752 language has 58 instructions and operators, including commands for accessing the I<sup>2</sup>C bus and analog inputs and bit-control operators for reading from and writing to individual port bits. Direction-control variables protect Ports 1 and 3 by preventing you from writing 0 to a bit when it's configured as an input.

BASIC-752 isn't as interactive as the BASICs on other boards. Using it is more like using a compiled language than an interpreter. For example, there's no command mode for entering and immediately executing commands. Also, writing and running a program involves several steps. First, you must write a program using a text editor and save it to disk. Next you run a tokenizer program that translates the BASIC statements into a series of tokens or abbreviated codes. You then use Iota's software or any terminal-emulation program to send the token file to the SC-75's EEPROM. On boot-up, the BASIC interpreter then runs the program automatically by reading the stored tokens and translating them into a series of machine codes to execute.

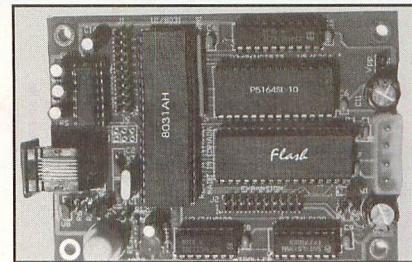
Since the language doesn't have a PRINT instruction, there's no simple way to view variables or memory locations on-screen while a program runs. However, what you do get is BASSIM, a program that uses a personal computer to simulate running BASIC-752 programs. With the simulator, you can test and debug software before you upload it to the SC-75 board.

The simulator lets you view and change port values, including the analog ports and I<sup>2</sup>C bus; enable interrupts and the timer; view the stack; set and display watch variables; and set breakpoints. You can load and run a program at full speed, in slow motion or by single-stepping. The simulator and Iota's development software require a '386 or later computer.

The SC-75 has complete documentation, including data sheets and the specification for the I<sup>2</sup>C bus. Iota also sells some of those hard-to-find I<sup>2</sup>C components, including analog and digital I/O chips and keypad and LCD interfaces.

### LS Electronic Systems Design EMC32F

LS Electronic's \$80 EMC32F is an 8031 microcontroller with 40K of Flash EEPROM and 8K of RAM. Another 8K of Flash EEPROM stores a monitor program and Flash memory manager, for viewing and changing memory, running programs, loading Intel Hex files into RAM and programming Intel Hex files into the Flash EEPROM.



You can use the monitor program with the provided Kermit terminal emulator or your own software. Cables are available for the serial connector (RJ-11 to DB-25 for \$8) and power (Molex to stripped and tinned wire ends for \$4).

Programming the Flash EEPROM requires an additional 12-volt power supply. To store a program, you select the Flash Memory Manager in the monitor program. You then select Program and use your terminal emulator to upload your file to the board. The monitor program takes care of the programming details.

The Flash EEPROM is a 28F001BX, which actually is a 128K device, though much of it is unused on this board. Since the 8031 can access just 64K of read/write memory, the 128K is divided into two pages. Page 0 contains the monitor program and user-program storage. Since the remaining 16K in the memory area is used by RAM and I/O, it's not accessible in the Flash EEPROM.

Page 1 contains another 64K. However, the monitor program can't access this page. Consequently, there's no convenient way to program it or perform the other monitor functions. Still, the available 40K is plenty for many applications. The memory can endure at least 10,000 erase/write cycles.

You get a printed schematic and an excellent 47-page manual on-disk. The manual includes start-up instructions, hardware and software details, good explanations of the circuit design and even some tips on how to write and develop programs.

The disk also contains source code for the monitor program, which is also well-documented. So you can study the code and even change and reassemble it if you wish. A variety of application notes with source code and schematics are available. You can also buy the board in kit form for \$60 and solder the components into place yourself.

### Micromint Domino-52

Micromint's \$79 Domino-52 is an 80C52-BASIC system in a 1.75" X 1.1" package. Inside Domino are an 80C32 microcontroller and 32K each of EEPROM and RAM.

All of the chips and other components are hidden inside Domino's potted pack-

(Continued on page 98)

# Navigating the PCMCIA Maze

PCMCIA basics, the new PCMCIA Card Standard and two new PCMCIA product reviews for your consideration

**A**nyone who has endured the problems caused by the diminutive PCMCIA socket on most notebook computers will appreciate the new PC Card Standard announced late last year. It promises welcome relief. Not that things haven't been getting better, anyway. Up to now, though, working with anything associated with PCMCIA—the socket, the card, the software—has been similar to negotiating a complex maze. Wrong turns are everywhere, but as you begin to figure out the best route, things become much easier.

To help get you through the PCMCIA maze as painlessly as possible I'll provide you with something like a

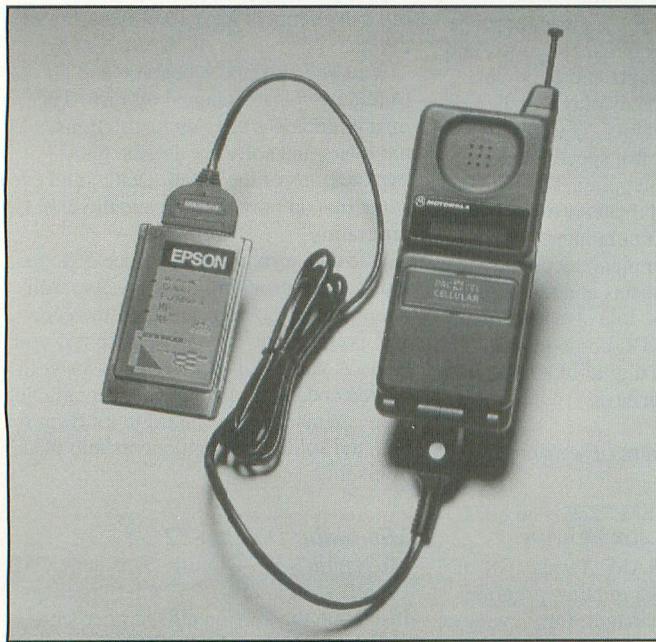
map that consists of four parts: a brief review of the basics; an in-depth look at the new PC Card Standard; a whirlwind tour of the latest PC Card products; and hands-on reviews of two new PC Cards.

## PCMCIA Basics

PCMCIA stands for Personal Computer Memory Card International Association. Though PCMCIA is the organization that has produced the new PC Card Standard, most people refer to the sockets as PCMCIA sockets, to the cards as PCMCIA cards and to any associated software as PCMCIA drivers.

Since a PCMCIA socket is probably the first thing you notice when you purchase a notebook computer, let's take a look at it first. Of course, PCMCIA sockets aren't meant for only notebooks. You'll find them in subnotebook, palmtop, PDA and even desktop computers—not to mention all the other electronic products, such as personal communicators and test equipment, that incorporate these sockets into their design.

Your particular computing device probably has either one or two sockets, but it can have more. The sockets vary in size. Most are Type II, but they can also be Type I or III. Type IV sockets haven't yet been incorpo-



Epson Cellular Fax/Modem connects directly to any Motorola MC2 data-capable cellular telephone, as well as to any standard telephone line.



Panasonic's KXL-D720 CD-ROM drive is bundled with a PCMCIA Type II card. Drive weighs less than a pound, and cost of bundled pair is considerably less than purchasing separate components.

## A How-To Guide for PC Card Developers

PCMCIA has developed a number of guidelines to assist developers of PC Card products. These provide "how to" guides for implementing the PC Card Standard. The guidelines are as follows:

(1) *Enabler Capabilities and Behavior*. Enablers are Card Services clients (that is, they use the Card Services interface) that operate on host systems to enable and configure PC Cards and host systems as they're plugged into and removed from the PC Card host.

This guideline recommends the capabilities that all enablers should provide and proscribes certain behavior. Following this guideline minimizes access collisions between the enabler and other clients and between independent enablers, thus enhancing the level of functionality to users.

(2) *Card-Application Interaction* outlines how PC Card-aware and PC Card-unaware applications should interact with a PC Card. In any given PC Card system, there can be both PC Card-aware and PC Card-unaware applications. Both of these types of applications may wish to access a PC Card and could react very differently to changes in card status. This guideline defines a minimum standard of "good behavior" in several common situations.

(3) *FAX/Modem CIS Design* describes CIS design of for a single-function 9,600/ 2,400-bps fax/modem PC Card. Much of the information in this guideline is also applicable to multiple-function PC Cards.

(4) *Wireless CIS Design* provides information on the CIS for a wireless-modem PC Card.

(5) *PC Card ATA CIS Design* describes PC Card ATA CIS considerations and provides examples of how they're used in these cards.

(6) *CardBus Operational Scenarios*. The client to Card Services interface for CardBus cards is similar to that of cards that don't use CardBus. Processing done by the PC Card technology software is different for CardBus, even though a common interface is maintained. This guideline describes the processing done by the PC Card technology software.

(7) *CardBus/PCI Common Silicon* provides specific details of how to design a hardware component so that it can be used in both a CardBus PC Card and in the PCI environment that's directly connected to the PCI bus.



New Media Multimedia Combo card combines 16-bit sound and a SCSI II connector on same card. This is ideal for multimedia applications because you can attach a CD-ROM drive to card, as well as obtain audio output from it.

rated into the standard, though they do exist. Each size is a different thickness, with Type I being the thinnest at 3.3 mm. No matter what the size of the socket, however, all contain a standard 68-pin connector.

Inside the computer, the socket connects to a PCMCIA host controller, which has been the source of some incompatibility problems in the past. The most-compatible controllers have been the ones manufactured by Intel and Vadem. Unfortunately, it's often difficult to tell which host controller is being used in a particular portable computer.

For every PCMCIA socket there's a raft of PC Cards that you can slide into it. Flash memory, data/fax modems, network adapters and hard disks are just a few of the peripherals available on these credit-card sized modules. Like the sockets, PC Cards come in different thickness, which are identified as Type I, II and III. For the most part, PC Cards can be "hot swapped," which means that you can pull one out and slide another one into place without having to turn off your computer.

Getting a computer to recognize the PCMCIA socket is the job of software called Socket Services. Other software, called Card Services, automatically allocates system resources, such as memory and interrupts, once Socket Services detects that a PC Card has been plugged in.

Two of the major PCMCIA software providers are SystemSoft and Phoenix. Typically, Socket Services and Card Services software are pre-installed on a portable computer.

Some manufacturers of PC Cards also provide software drivers of their own.

This sums up the PCMCIA basics part of our maze map. If you want further information on this part, refer to the March/April 1994 issue of *MicroComputer Journal*.

## The New Standard

The new PCMCIA PC Card Standard integrates the previous standards from both PCMCIA and JEIDA (Japan Electronic Industry Development Association), along with many new features, into a single common standard that's available from both organizations. While previous versions of the standards from the two organizations were similar, they weren't identical. And while regional-specific standards, where necessary, are still supported by each organization, this new standard provides a single common global standard for PC Card technology.

Another change that has occurred with this release is elimination of revision or release numbers. Unlike software products, for example, where revision numbers are often used to denote data or file format compatibility, PCMCIA revision numbers have caused considerable confusion among users. Products advertised as being compatible with the same revision of the standard may not be designed to work with each other, while products advertised as being compatible with different versions may work perfectly well together. The PCMCIA organization believes it's more important for users to select PC Card products based on the features and capabilities they support, rather than relying on release numbers.

Many new features have been included in the new standard, the majority of which are options for developers. These can generally be classified into three categories: compatibility, current and near-future technology needs and future technology needs.

## Compatibility

The development of this new standard doesn't mean that the current PC Card technology will become obsolete. To the contrary, the large installed base of PC Card products that are working well will continue to be just as viable under the new release (see "What It

Takes to Make PC Cards Work" elsewhere in this article). This release allows for backward compatibility with existing products to the greatest extent possible.

In keeping with the continuing emphasis on compatibility, a number of enhancements are included in the standard to foster seamless interoperability of PC Card products. These enhancements include expanding the information within the card information structure (CIS) on which host systems depend to reliably configure cards, providing guidelines for developers in implementing products based on the PC Card Standard (these are official "how-to" guides) and documenting formats for storing information on flash media.

In addition, a specific hardware-compatibility enhancement has been added to address the power a system must supply to identify and then configure or turn off a card. A card that operates at more than a nominal level of power must remain below the specified limit until the system has an opportunity to examine its CIS to determine the card's power requirements.

With this revision, the CIS is now a required PC Card element. In addition, the new PC Card Standard has an augmented metaformat specification, and the specification itself has been reformatted and reorganized to make it easier to read and implement. Expanded and enhanced CIS information in the new PC Card Standard includes:

- A requirement that all cards contain a CIS that describes the functionality

## What It Takes to Make PC Cards Work

How do a system and a PC Card interact when they're "compatible?" For a PC Card to operate properly, the host must first be able to provide adequate power at the correct voltage(s) to identify and operate the card. It must then successfully identify the card by reading its card information structure (CIS) and, in some cases, by sensing several pins on the interface. These pins are important in systems that are mechanically able to accept CardBus or other low-voltage cards. The CIS contains detailed information on a card, including its permitted "configurations," which tells the host system the various ways the card can be set up and what system resources are required.

Once the card has been identified, the system must determine if the card requires a user-installed Card Services client driver (typically LAN cards, SCSI cards, sound cards and CardBus cards). If no user-installed driver software is located, the system determines whether the card can be supported by the host's built-in Super Client driver (typically

memory cards, ATA devices and fax/modems). The host then links the card with the appropriate driver and configures the card and socket.

In the case of a data-storage device like a memory card or disk drive, the file system must be able to access the data on the card. This sometimes requires a link to be established with a specific installable file system.

A user may want to suspend and resume operation of a notebook (or Energy Star desktop) PC with PC Cards in the slots. To do this successfully, a card-specific routine must communicate with the Advanced Power Management (APM) software, which must then access the card through Card and Socket Services.

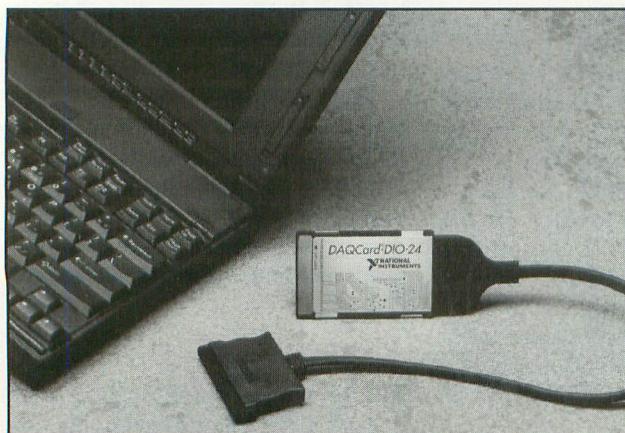
Lastly, Card Services Enablers and Client Drivers must operate consistently from one card supplier to the next and be as flexible as possible to automatically accommodate varying system configurations. Also, card-aware application programs, like communication programs, need to coexist with older application programs.

and characteristics of the card and remains valid for all times after initialization.

- Addition of descriptions for low-voltage cards, DMA capability, a new high performance CardBus, multiple function cards, wireless communication cards and enhancement of the descriptions for modem cards.
- Addition of CIS guidelines that provide additional assistance in construc-

tion of CIS to enhance recognition and usability of cards by a variety of system software.

These CIS improvements will allow developers of products based on the PC Card technology to incorporate expanded information within PC Cards and improve recognition of PC Cards and capabilities within host systems. For the end user, this will mean improved compatibility be-



DAQCard-DIO-24 from National Instruments is a Type II PCMCIA card with 24 digital I/O lines that turns a notebook into a digital I/O controller with transfer rates up to 250K B/s, and can be used for laboratory testing, production testing and industrial process monitoring and control applications.



Epson's DYO combines full-function PCMCIA reader/writer Type III socket with 1.44M 3 1/2" floppy drive in half-height format.

MANUFACTURER	MODEL	PRICE	COMMENT
3COM	ETHERLINK III	\$228	
3CON	ETHERLINK III COMBO	\$288	
ACCURITE TECHNOLOGIES INC.	TRAVEL FLOPPY 144 COMBO	\$249	
AMP	FLASH 5	\$95	
AMP	FLASH 5	\$120	
AMP	FLASH 5	\$170	
AMP	FLASH 5C	\$276	
AMP	FLASH 5C	\$141	
AMP	FLASH 5C	\$198	
AMP	FLASH 5C	\$299	
AMP	FLASH 5C	\$500	
ANGIA COMMUNICATIONS INC.	SAFE JACK 19.2Kbps	\$249	
ANGIA COMMUNICATIONS INC.	SAFE JACK 28.8Kbps	\$389	
ANGIA COMMUNICATIONS INC.	SAFE JACK CELLULAR 19.2	\$259	
AUDIO EXPRESS	MOBILE DIRECT	\$309	
APEX DATA INC.	MOBILE DIRECT	\$129	
APEX DATA INC.	MOBILE PLUS CELLULAR	\$259	
APEX DATA INC.	MOBILE PLUS V.34	\$499	
APEX DATA INC.	MULTICARD	\$549	
APEX DATA INC.	TOEKEN-RING	\$449	
APEX DATA INC.	V.FAST SLIM LINE	\$399	
AT & T	KEEP IN TOUCH CELLULAR MODEM	\$289	
AXONIX CORP.	PROMEDIA PLAYER+	\$519	
CARDINAL TECHNOLOGIES	MVP44CC	\$129	
CARDWELL	SOUND/SCSI	\$369	
CENTENNIAL TECHNOLOGIES	PALM FLASH	\$55*	
CENTENNIAL TECHNOLOGIES	PALM FLASH	\$94**	
CENTENNIAL TECHNOLOGIES	PALM FLASH	\$135**	
CENTENNIAL TECHNOLOGIES	SERIES 1 FLASH CARD	\$380*	
CENTENNIAL TECHNOLOGIES	SERIES 1 FLASH CARD	\$94**	
CENTENNIAL TECHNOLOGIES	SERIES 1 FLASH CARD	\$135**	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$231*	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$133**	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$253**	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$483**	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$945**	
CENTENNIAL TECHNOLOGIES	SERIES 2 FLASH CARD	\$1,153**	
DARDISP	DARDISP	\$1,456	
COMMUNICATION AUTOMATION & CONTROL	10 BASE-T	\$995	
EPSON AMERICA, INC.	10 BASE-T	\$159	
EPSON AMERICA, INC.	14.4 DATAFAX	\$169	
EPSON AMERICA, INC.	170 MB HDD	\$439	
EPSON AMERICA, INC.	250 MB HDD	\$559	
EPSON AMERICA, INC.	ATA FLASH RAM	\$299	
EPSON AMERICA, INC.	ATA FLASH RAM	\$349	
EPSON AMERICA, INC.	ATA FLASH RAM	\$529	
EPSON AMERICA, INC.	ATA FLASH RAM	\$899	
EPSON AMERICA, INC.	CELLULAR DATA/FAX 14.4	\$1,689	
EPSON AMERICA, INC.	FAXPORT 14.4	\$239	
EPSON AMERICA, INC.	SRAM	\$159	
EPSON AMERICA, INC.	SRAM	\$269	
EPSON AMERICA, INC.	CD40	\$128	
EXP COMPUTERS INC.	THINFAX 288C	\$449	
EXP COMPUTERS INC.	THINFAX 288I	\$399	





tween PC Card products.

PCMCIA has also developed a number of guidelines to assist developers of PC Card products. These guidelines provide developers with "how-to" guides for implementing the PC Card Standard (see the "A How-To Guide for PC Card Developers" box). By following these guidelines, developers will enhance the compatibility of their PC Card products with others that follow the same guidelines.

The Media Storage Formats Specification describes data structures and formats for various flash filing systems and PC Card/ATA devices to facilitate card data interchange under a wide range of circumstances (see the "The PC Card ATA Mass Storage Standard" box). These include adoption of a standardized low-level "data-blocking" format and the related "dash translation layer" for block-oriented flash-memory cards. Similar information is included for PC Card ATA devices, including a description of the data structure in the FAT file system.

This specification is intended to promote exchange of these cards among different host systems. PCMCIA's documenting of data formats should enhance compatibility and the ability to interchange for end users.

## Current & Future Needs

The new PC Card Standard includes several new features that address both current and near-future needs. These are: low-voltage support, multi-function card support, DMA and a power-management interface.

More and more of the electronic components used in portable computing platforms nowadays are capable of operating at 3.3 volts, which provides considerable power savings and extended battery life. The new PC Card Standard allows for host systems and PC Cards to operate solely at 3.3 volts.

Until this new standard, PC Cards and hosts had to be capable of operating at 5 volts, if only to read the CIS on a card and recognize that it could operate at a lower voltage. Now PC Cards and host systems can operate directly at 3.3 volts, thus saving power.

This change has affected the PC Card Electrical Interface Specification

TOSHIBA	FLASH MEMORY CARD/INAND	\$255	X	8 MB
TOSHIBA	FLASH MEMORY CARD/INAND	\$305	X	10 MB
TOSHIBA	FLASH MEMORY CARD/INAND	\$458	X	16 MB
TOSHIBA	FLASH MEMORY CARD/INAND	\$559	X	20 MB
TOSHIBA	FLASH MEMORY CARD/INAND	\$660	X	24 MB
TOSHIBA	PCMCIA FLASH STORAGE	\$291	X	3 MB
TOSHIBA	SPORTSTER 14.4	\$1,445	X	40 MB
US ROBOTICS	SPORTSTER 28.8	\$259	X	14.4/14.4 DATA/FAX, V.32bis, MNP 5, RJ-11 CABLE
US ROBOTICS	PCMCIA144	\$499	X	28.8/14.4 DATA/FAX, V.34, MNP 5, RJ-11 CABLE
VEN-TEL	ETHERNET + MODEM II	\$449	X	14.4/14.4 DATA/FAX, V.32bis, MNP 5, RJ-11 CABLE
XIRCOM	PS CREDIT CARD ETHERNET ADAPTER	\$699	X	ETHERNET 10 BASE-T/100 BASE-T/1000 BASE-T, 14.4/14.4 DATA/FAX, V.32bis, MNP 5, RJ-11 CABLE (CEM2-10BT)
XIRCOM	PS CREDIT CARD ETHERNET ADAPTER	\$349	X	ETHERNET 10 BASE-T/100 BASE-T/1000 BASE-T, 14.4/14.4 DATA/FAX, V.32bis, MNP 5, RJ-11 CABLE (PS-CE2-10BT)
XIRCOM	TOKENRING ADAPTER	\$269	X	TOKENRING DB9, RJ-45, CABLES FOR SPIN D (PS-CT2-16CIP)
ZENITH	Z-PLAYER	\$499	X	2xCD-ROM DRIVE, 320ms, INTEGRATED MICROPHONE

NOTE: "X" denotes use of Stacker Compression software.  
\*\*\* - Price if ordering directly from the manufacturer

10 BASE-T = TWISTED PAIR CABLING WITH RJ-45 CONNECTOR  
10 BASE-2 = THIN COAX (RG-58) CABLING WITH BNC CONNECTOR  
ATC=Advanced Parallel Technology  
ETC=Enhanced Throughput Cellular  
PS=Performance Series  
FNU=Flash Memory Upgradeable  
EC2=Enhanced Cellular Control  
DCCT=Direct Connect Cellular Technology  
DAA=Data Access Arrangement

## DMA Vs. CardBus

The new PC Card Standard includes both CardBus and the DMA specification. However, uses for the two are really quite different. CardBus is a new interface for PC Cards and is similar to the PCI bus. PCI is capable of 32-bit data transfers and bus mastering. It also multiplexes the address and data lines to reduce pin count and is, therefore, ideal for the 68-pin PC Card interface.

CardBus offers a wider and faster bus for greater bandwidth communication with the CPU. In addition, it also permits peripherals to become bus masters. What this means is that peripherals can take over the system bus directly instead of having to work through the DMA controller as an intermediary. This offers the advantage of permitting much more flexibility in the peripheral regarding how and where the data will be transferred.

The price to be paid for this added flexibility is in capital outlay. Much more circuitry is required for a peripheral to implement a bus-master scheme than is required for a DMA implementation.

There's also an issue with application compatibility. Very few applications permit bus mastering. In addition, since the ISA bus didn't permit easy bus mastering, it wasn't built into very many of the available peripherals and applications. How well bus mastering catches on in software will depend on how well PCI and CardBus catch on in the next wave of computers.

Another difference between CardBus and DMA is that CardBus will be very difficult to implement on an ISA bus. This means that CardBus won't be available in portable devices that don't embrace an advanced bus like PCI. If computer users choose ISA instead (still very popular, especially in portables), they can still implement the DMA very easily.

The opposite is also true. It's difficult to implement DMA for PC Cards on a computer that has a PCI bus. In addition, application compatibility that's so important for the DMA specification may not be possible to maintain on the PCI bus.

DMA and CardBus interfaces aren't at odds with each other. There are some applications that require a reduced amount of CPU overhead but not all of the cost of bus mastering. These are candidates for DMA. Other applications require performance and would benefit from the flexibility and performance of bus mastering and are candidates for CardBus.

and Card Physical Specification with addition of two new signal lines and a physical keying mechanism for 3.3-volt cards.

While dual-voltage cards and hosts are permitted, there now exists a condition under which certain cards won't plug into certain systems. For instance, 3-volt-only cards won't fit into 5-volt-only sockets. Conversely, a 3-volt-only host will accept a 5-volt-only card but won't be able to operate it (it won't damage it, either). As a practical matter, this isn't likely to be an issue in the short-term because most low-voltage-capable hosts will also handle 5-volt cards, but an increased level of end-user awareness of card and host capabilities will be required.

The new PC Card Standard recognizes that developers of PC Card products can now place more functionality in the PC Card form factor. Providing multiple functions on a single PC Card. For example, modem and LAN allows the same number of PC Card sockets on a host system to have more functionality. The bulk of the changes concern hardware on the PC Card, Card Services interface and CIS. No changes are required to the Socket Services interface or socket controllers. This allows for maximum backward compatibility with existing host systems.

Any system that supports I/O PC Cards may support multiple I/O function cards with an update to its Card Services implementation. In some cases, specific client device drivers may even eliminate the need for updated Card Services.

Many current applications, such as sound cards, make use of industry-standard DMA capabilities (see the "DMA-Versus-CardBus" box). Previous versions of the standard required DMA to be emulated in software. The new PC Card standard allows PC Cards to utilize DMA technology when matched with a corresponding host system. This can provide increased performance, thereby expanding and enhancing the number of PC Card-technology products.

In keeping with the continuing PC industry effort to reduce power consumption for both environmental and battery-conservation reasons, the PC Card Standard now provides a means of interfacing to APM (Advanced

Power Management) through the Card Services Specification.

This initial interface to the current industry-standard software mechanism for power management, along with the new low-voltage capabilities, provides many power-saving capabilities in the new standard.

## PCMCIA CardBus Future

The older PCMCIA PC Card specification provided performance capabilities that are equivalent to the ISA bus. Obviously, a means for attaching high-performance 32-bit expansion cards needed to be established. CardBus was developed to enable this capability while maintaining support for existing PC Cards.

The CardBus interface introduces several important new capabilities and functions to PC Card applications, among them:

- 32-bit multiplexed address/data with parity on the PC Card's 68 pins
- 132M/second peak bandwidth at 33-MHz clock frequency
- Maximum 33-MHz clock frequency
- Support for Bus Masters on PC Cards
- Platform and operating-system independence
- Backward compatibility
- Interface power management
- 3.3-volt (or lower) operation
- Remote wake-up
- Dynamic reconfiguration
- Improved audio capability
- Non-customized multi-function card support

CardBus presents an opportunity to developers to expand the set of applications now available to PC Card users. The new interface will support operational speeds up to 33 MHz.

The CardBus interface supports multiple bus functions, which can be implemented in any combination. Use of a bus-master function allows the system processor to be off-loaded. This is a very important factor in multitasking environments and can lead to improved system throughput.

The CardBus interface supports the existing PC Card Audio Digital Waveform mode and a new Pulse Width Modulation (PWM) audio mode. Both the Audio Digital Waveform and the PWM mode are optional in CardBus and must be en-

## PC Card ATA Mass Storage Standard

The original PC Card Standard was developed to provide standardization of memory-card form factors and recognition protocols that promote easy interchange of data among a variety of computer platforms. A significant improvement in the level of storage-card interoperability and host-software simplicity occurred with introduction of the PC Card ATA Standard.

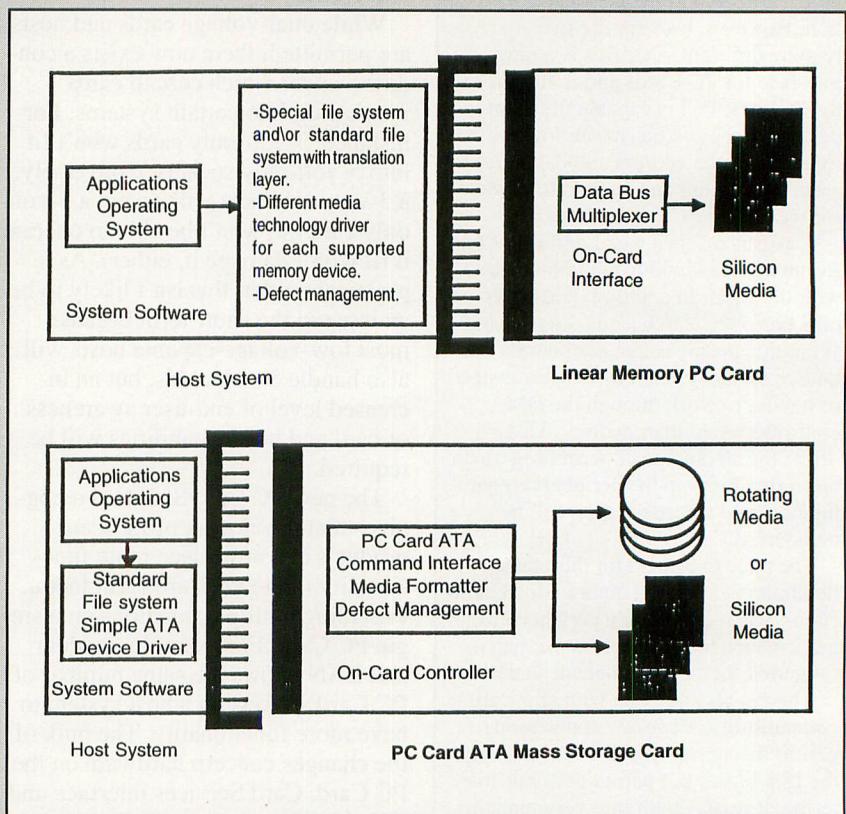
The PC Card ATA Standard adapts to PC Cards the industry-standard ANSI ATA (IDE) interface with its widely used 512-byte blocks. Implementation details of the rotating and silicon storage technologies on each card are hidden from the system by a sophisticated controller that's embedded in each card.

PC Card ATA device characteristics make them an excellent choice for such mass-storage applications as program and data storage or for use as an operating-system boot device. However, the embedded controller and block-oriented protocol make PC Card ATA products unsuitable for replacement and extension of main system RAM and direct execution of software from the PC Card. Main-memory expansion and direct execution from a PC Card are better served by linear memory PC Cards on which the memory chips are directly accessed by system software.

The PC Card ATA Standard defines the requirements for interchangeable mass-storage PC Cards that use the ANSI ATA protocol for operation. These PC Card ATA mass-storage cards configure into a PC Card socket just like any other PC Card defined by the PC Card Standard, but they operate under the protocol defined by the ANSI ATA Attachment Interface for Disk Drives (ANSI X3.221-1994).

The unique features of PC Card ATA products are made possible by the embedded controller on the PC Card. This sets them apart from linear memory PC Cards that use Flash, EEPROM or similar memory technologies. The embedded controller performs the tasks of media management and error management that must be performed by host software with linear memory PC Cards.

Media management is an important task because each general type of storage technology—as well as each generation and, in some cases, each IC part number—uses its own unique algorithms for reading and writing. With linear memory



Memory PC Card versus PC Card ATA host and card implementations.

products, adding support for a new vendor or generation requires updating the algorithms in the system used to access the PC Card.

The PC Card ATA Standard permits these algorithms to be incorporated directly into the PC Card that contains the memory, making it completely transparent to the host system and software. Using linear memory cards requires that device-specific access routines, called Memory Technology Drivers, be ported to and resident on each platform into which the PC Card may be inserted.

Because many linear memory PC Cards don't have the simple 512-byte block organization provided by PC Card ATA, they can require specialized file systems or translation layers. These add to system complexity and occupy many kilobytes of system RAM. PC Card ATA's standard 512-byte block disk-like interface and controller make it possible to overcome all of these difficulties.

The drawing illustrates the basic organization of a traditional linear memory storage PC Card and a PC Card ATA stor-

age card and the matching host system software requirements. Both use the standard PC Card Electrical Interface and normally use Card and Socket Services for controlling the host's PC Card sockets. All tasks performed by the controller in the PC Card ATA mass-storage card must be handled directly by system software when using linear memory PC Cards.

The PC Card ATA Standard has been enhanced in the PC Card Standard. Low-voltage storage cards have been added, and the card recognition protocol has been upgraded to permit two drives on a single PC Card. Sections have been included in the new Media Storage Formats Specification to document the partitioning mechanism for placing several file systems on ATA PC Cards. It also documents the DOS FAT file system, which is most frequently used to transfer data between systems on these cards.

Future dual drive cards may incorporate such features as both read-only and read/write drives on a single PC Card or a PC Card with a mixture of storage technologies.

## What Is Flash RAM?

Flash memory, which is the basis of PCMCIA flash cards, is a class of silicon memory that has features that differ from other types of memory like DRAM, SRAM and EEPROM. The major characteristics of flash memory are: non-volatility, electrical erase-ability, a limited number of erase cycles (approximately 100,000), a simple single-transistor cell (with current chip densities at 16M bits) and 12-volt programming potential. Flash chips must be erased before being written to. Erasure is done in large blocks, using the programming voltage to produce electron migration that changes logic states.

Just as there are many kinds of DRAM, there are many kinds of flash. Flash memory has two main differences. One is in the structure of how the individual flash cell is built. Examples are Intel's stacked-gate approach and SunDisk's triple-poly flash cell. The other is in the architecture of the array. Competing flash architectures are the industry-standard

NOR flash, ETOX (EPROM with Tunnel Oxide) NOR flash from Intel, NAND flash from Toshiba and Samsung, DINOR (Divided Bit-Line NOR) flash from Mitsubishi and AND flash from Hitachi, Ltd.

Since flash memory cells wear out with use, wear-leveling algorithms are needed to move sectors so that no particular sector is used more often than another. The 16M-bit flash component can be used with wear-leveling algorithms to provide more than 1-million erase cycles per block.

PCMCIA flash cards are based on 8M- and 16M-bit flash-memory chips. These cards can be either PCMCIA-ATA flash cards (also called disks or drives) or PCMCIA flash memory cards.

PCMCIA-ATA flash cards, which emulate disks, pack on-card CPUs, firmware and control logic to handle logical-to-real-address translation. The CPU also generates required commands and handles wear leveling. Such ATA cards

also have read/write buffers and possibly built-in dc-to-dc programming voltage up-converters. ATA flash cards provide serial, rather than random, access. SunDisk, IBM and others manufacture PCMCIA-ATA flash cards.

PCMCIA flash-memory cards work with the host CPU and host software called Flash File System or FFS. FFS software allows the PCMCIA flash card to appear as a hard disk drive to the operating system. FFS manages flash's fixed 512 byte to 256K erase-block sizes and implements wear-leveling. (Intel recently licensed M-Systems TrueFFS flash file system that, according to reports, provides a faster and more efficient means of hard-disk emulation than Microsoft's FFS-II.) PCMCIA flash cards preserve the random-access capability of the flash components and can be used in card XIP (execute in place) applications. Thus, programs can be run by the CPU directly in flash memory without being first copied to system DRAM.

abled by system software before they can be used. The operating range of PWM audio is significantly improved over that provided by the Audio Digital Waveform signal.

While CardBus has been defined with system platform-independence in mind, it's intended for use on 32-bit systems. Systems that employ a 16-bit bus will realize little, if any, benefit from a CardBus interface. The ability to interchange between systems that employ CardBus will be significantly increased due to several features of the new specification. Also, the CardBus specification includes a definition of the minimum requirements for cards, sockets and adapters.

The CardBus interface signaling protocol is derived from the Peripheral Component Interconnect (PCI) Local Bus signaling protocol. Though there are some differences between PCI and CardBus, operations are identical for most functions implemented.

The CardBus software model is shared with that for 16-bit PC Cards. Since a 32-bit Card Services interface is also defined for 16-bit PC Cards, this permits the same Card Services client to be used to manage both CardBus and non-CardBus PC Cards.

Since CardBus cards and sockets use the Low Voltage Key defined for 3.3-volt cards, CardBus cards must be

designed for 3.3-volt or lower operation. This will reduce system power requirements and extend battery life.

In addition, all CardBus cards must use a limited amount of power upon initial power-up or reset until after the card is configured. This specification permits the card CIS to be read, from which it may be determined whether the system is capable of providing sufficient power and other hardware resources for the card to function properly. The power-on current limit prevents instantaneous battery drain and enables the system to gracefully reject the card if it isn't capable of providing the necessary power for operation.

CardBus sockets must be able to accept and support all 16-bit PC Cards within the constraints imposed by the host system. For example, a 5-volt-only PC Card can't be supported in any system that supplies only 3.3 volts, which is true for both CardBus and non-CardBus interfaces.

The CardBus interface supports insertion and removal of cards while a system is powered-on (dynamic re-configuration). The socket must be powered-off when a card isn't present. To the user, this appears as though the socket is "hot" during insertion and removal events.

As I already mentioned, the Card-

Bus interface is required to also support PC Cards that don't utilize CardBus. By interrogating the card when it's inserted, the PC determines whether or not the card requires CardBus support and then applies the appropriate amount of power and resources. This interface is designed to prevent damage to the inserted card.

The Card Detect/Voltage Sense algorithm provides for two future lower voltage levels. All CardBus and low-voltage non-CardBus cards are required to support this detection algorithm, which enables CardBus adapters to recognize any PC Card in any socket. The adapter provides information to enable associated software to determine whether the inserted card can be supported and, if not, an opportunity to gracefully reject it.

Socket Services is provided independent of whether or not an adapter supports CardBus. However, different Socket Services implementations are required for each unique adapter design. A single host system can contain adapters that support only CardBus, and there are those systems that don't. It follows that the corresponding Socket Services handlers can also co-reside in a single host system. Minimum Socket Services functionality is required for all adapters.

Card Services is used to provide a

*(Continued on page 105)*

# Alternative Input Devices

## Ergonomic keyboards and mice, voice recognition...and more

**D**uring the 15 years or so of the existence of personal computing, there has been a staggering growth in work-related illnesses that can be directly attributed to the increased use of desktop computers. The Bureau of Labor Statistics identifies ergonomic disorders as the most rapidly growing category of work-related illnesses.

In 1992, for example, 56% of illnesses reported to the Occupational Safety and Health Administration (OSHA) were work-related. This compares with only 18% in 1981 and 28% in 1984. No precise figures on the rate of injury among office workers exist, but the dramatic rise in cases does coincide with the proliferation of personal computers in today's workplaces and homes.

Injuries related to PCs have also led to many computer users filing law suits against hardware manufacturers, such as a former DuPont employee's suit against IBM, Hewlett-Packard and Microsoft in November of 1994 for a jury trial and unspecified damages, claiming use of an IBM keyboard, HP PC and Microsoft Mouse caused various ailments and that the manufacturers "failed to warn or advise plaintiff and others of the dangers" of their equipment.

This crippling epidemic has caused the computer industry to design more ergonomic computer peripherals and offer new ways to input commands and data to your microcomputer. In this article, I discuss some of the more-popular of these.

### Problem & Possible Solutions

Illnesses related to computers are referred to as Repetitive Strain Injury (RSI), Repetitive Stress Disorder (RSD) and/or Cumulative Trauma Disorder (CTD). The common causative factor is the personal computer, which, by simplifying everyday tasks in the office and the home, has insinuated

itself into just about every aspect of our lives. Anyone who uses a PC on a full- or part-time basis can suffer from RSI as a result of extended use.

RSI encompasses damage to the muscles, tendons and nerves. For PC users, injury generally results from uninterrupted typing with awkwardly situated or inappropriate equipment, such as a keyboard placed too high or an ill-fitting chair. Symptoms range from persistent aches in forearms and wrists to pain that extends from shoulder to finger tips and can even result in annoying and severe back aches.

The most common RSIs are tendonitis, epicondylitis, tenosynovitis, carpal tunnel syndrome and thoracic outlet syndrome.

Tendonitis is an inflammation and swelling of the tendons, with the hands, wrists and/or arms usually being affected.

Epicondylitis, or "tennis elbow," is a swelling of the muscle and connective tissues of the elbow.

Tenosynovitis is an inflammation of the synovial sheath that houses the tendon caused by calcium deposits, repeated strain or trauma that may restrict tendon movement and usually occurs in the hands and wrists.

Carpal tunnel syndrome (CTS) is a compression of the median nerve as a result of swelling of tendons and sheaths or repeated and prolonged bending of the wrist.

Thoracic outlet syndrome is a nerve disorder that can be caused by nerve-root pressure by a neck disk or by pressure of the middle nerve in the carpal tunnel and is marked by a morbid sensation of the fingers.

RSI is a cumulative-trauma effect. What begins as a sore arm can, if ignored and left untreated, escalate into full-blown disability. Days, weeks, months and years of typing gradually take their toll, until you eventually can't type anymore. Although the pain usually affects the dominant hand first, it's common to progress to both hands.



Microsoft Natural Keyboard.

Heavy reliance on personal computers is creating a staggering cost in the loss to US business. A case of RSI often costs \$15,000 to \$20,000 to treat, and a severe case can cost \$100,000 in medical and administrative expenses and lost productivity. Blue Cross of California, a heavily computerized insurance firm, spent an average of \$20,000 on each of 30 RSI claims in 1990. Multiply this by the thousands of people afflicted each year throughout the US, and you have a glimpse of the scope of this problem.

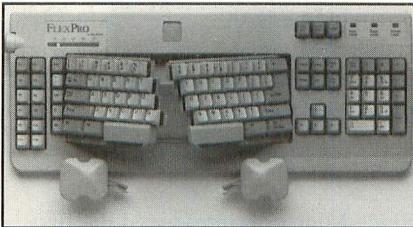
Responding to the RSI epidemic, dozens of hardware and software manufacturers have entered the booming market for ergonomic computer accessories and alternative input devices. PC users can buy a wide variety of products that range from wrist rests to keep their hands positioned correctly while typing to keyboards with hand- and wrist-friendly layouts; from braces that suspend your arms over the keyboard and mouse to software that prompts you to take a break from typing; and from pressure-sensitive tablets and touch-screen video monitors to optical-character-recognition (OCR) and voice-recognition software that virtually eliminate keyboard and mouse use.

### Keyboard Alternatives

Keyboard manufacturers are trying to lessen the risk of RSI by placing the keys at variable angles, making the keys more accessible and/or reducing



Lexmark Select-Ease Keyboard.



Key Tronics FlexPro Keyboard.



Lexmark Classic Touch 101-key keyboard with Pointing Stick and Erase-Eaze.



Lexmark's \$129 to \$149 Classic Touch and Enhanced QT keyboards have the standard QWERTY layout and offer two added features: an Erase-Eaze backspace key and a Pointing Stick input device. Erase-Eaze sets up half of the spacebar to work as a backspace key, permitting typists to remain on the home row while erasing. The Pointing Stick replaces a mouse with a pressure-sensitive joystick input in the center of the keyboard, with input buttons directly below the spacebar. A Lexmark keyboard with a 16- or 25-mm trackball is also available.

There's an embedded 10-key numeric keypad in the right key well, and you can use up to two optional foot pedals for shifting or any other keystroke. Touch typists will find that all letter keys are in just about the right places, though individual users may feel a particular key isn't positioned correctly. The Kinesis keyboard is programmable as well.

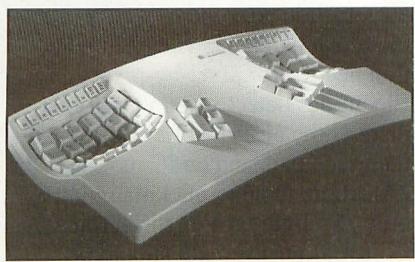
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Lexmark's \$179 Select-Ease Keyboard lets you split, swivel and tilt the keyboard. It has split halves and retractable legs that let you adjust width, height and angle for greater typing comfort. Other features include separate palm rests, a low-stepped profile and the Erase-Eaze backup key located next to the spacebar.

Marquardt Switches offers the \$179 MiniErgo keyboard that makes a few significant modifications to the standard layout. The keys are divided into two sections at either end of the keyboard. Between the two sets are the Delete, Insert and cursor keys. The keyboard is angled slightly (not adjustable) and has built-in wrist support.

Microsoft's \$99 Natural Keyboard offers the basic QWERTY key layout and splits the keyboard into two sections: angled so that your palms are turned inward when typing and a built-in palm rest with an adjustable rail beneath to keep your hands from angling above the wrist. Microsoft has added keys to make it easier to navigate *Windows* through new keyboard-sensitive Task Manager software. When *Windows 95* is released, the extra keys will be linked to its functions and plug-and-play technology.

If you're looking for a totally different way of typing, Infogrip's BAT (Biomechanical Automated Technology) Personal Keyboard is a one-



Kinesis Ergonomic Keyboard.



InfoComp one-handed data-entry BAT Keyboard.

typing effort. Last winter, Apple introduced a \$219 Adjustable Keyboard that splits into two pieces you can angle for greater comfort and maintain a flat design. The \$498 FlexPro from Key Tronic also splits in two, with both tilt and angle of the sections being adjustable and features built-in wrist supports that travel along a track in front.

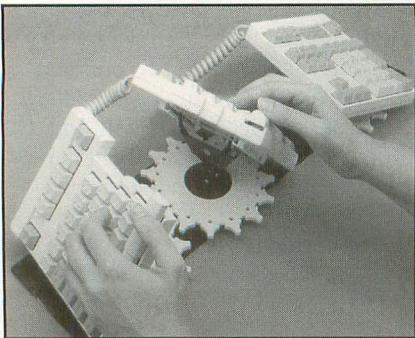
Ergonomix's \$275 MyKey keyboard features the familiar QWERTY key layout, built-in palm rests, function keys arranged on a clock face, a center-located trackball and front and rear elevators. The center-peaked V-shaped keyboard design helps in orienting hands and arms in a "natural" position to reduce stress.

Health Care Keyboard's \$675 Comfort Keyboard offers a totally adjustable typing system that splits the keyboard into three sections, each of which rotates and tilts to any position that's most comfortable for a given user. Distance between the sections is

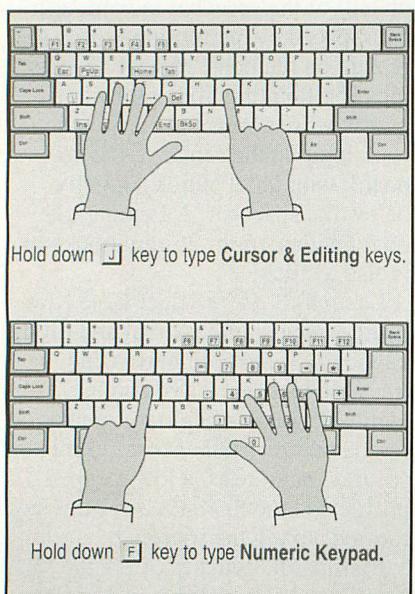
adjustable to conform to differing shoulder widths. The keyboard has a two-section arm-support system.

Touch typists might like the \$129 Starpoint 101 from Jefferson Computer Products. With it, you can access a numeric keypad and all cursor, function and editing keys without leaving the home row simply by holding down a single letter key. An included Menu Mouse can access drop-down menus in any window without your having to hit the Alt key.

The \$390 PC and \$490 Mac Kinesis Ergonomic Keyboard divides the standard keyboard in two, with keys set in two concave "dishes" on either side of the keyboard. The Delete, Backspace, spacebar, Ctrl, Alt, Home, End, Page Up, Page Down and Enter keys have been moved to redistribute the work load from the little finger to the thumbs. The bottom of the keyboard acts as a palm rest to support your hand as your fingers type, thus limiting unnecessary wrist motion.



Health Care Keyboard Comfort Keyboard System.



Jefferson Computer Products  
Starpoint 101 Keyboard shortcuts.



Marquardt MiniErgo Keyboard.

handed "chording device" that lets you input letters and commands using combinations of seven keys. The unit is small and light and includes software for programming macros. It's available for \$295 for single-handed and for \$495 for two-handed use. For-

tunately, the BAT can be used with a standard keyboard while you're learning. The keyboard is designed with a palm rest.

## Pointing Alternatives

Since Microsoft introduced the first pointing device in early 1980s, the mouse has been an alternative to the keyboard for issuing commands to a PC. Anyone who has used a mouse will notice that it's also susceptible to inducing RSI.

Microsoft's new \$59 Ergonomic Mouse 2.0 has a unique contoured design that's based on much research and user feedback and encourages your hand to rest on the mouse at a slight angle in a more-natural position for your wrist. The rear end of the mouse also bulges to the left to support the thumb of your right hand or the smaller fingers of your left hand. A snap-to feature makes the pointer appear automatically on the default button of a dialog box—which is a great time saver that may also reduce the risk of RSI.

Logitech offers many types of pointing devices, such as the \$49 ergonomic MouseMan, \$79 Track-Man II trackball stationary mouse and even a \$99 Cordless MouseMan. There's even a \$79 Kidz Mouse that's contoured small enough to fit nicely into a child's smaller hand and even resembles the familiar rodent.

If you're interested in truly remote mousing, RemotePoint from Interlink Electronics features a range of 40 feet. It uses single-button control for both cursor direction and speed, and its infrared receiver connects to a standard serial port or PS/2 mouse port. A sleep mode conserves power from its two AAA cells.

As part of its Synergy series, Key Tronic offers a \$99 ClikMate contoured-profile mouse and \$129 Trakmate on a Wrist Pad with an integrated four-button trackball. The free-standing adjustable Wrist Pad can sit in front of your keyboard to provide a comfortably padded surface for resting your wrists and palms.

Key Tronic also offers a Pacemate module for its Wrist Pad that monitors keyboard activity, work periods and rest times. An audible alarm sounds when it's time to rest.

Cirque's innovative \$99 GlidePoint



Microsoft Mouse.

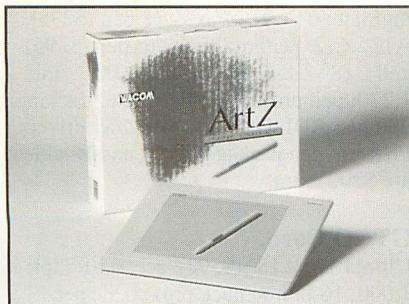
TrackPad for Macintosh and IBM PS/2 computers is a touch-sensitive mouse-substitute pointing device. It uses field-distortion sensing to determine the exact position of your finger's center point—the "centroid"—as you slide your finger gently over the touch pad to provide the resolution needed for pixel-by-pixel control. Electrodes detect when your finger distorts the electrical field emitted by the touch pad, and an IC measures the distortion. Double-clicking requires only two light taps on the surface. A PC serial-port version should be available in early 1995.

## Tablets

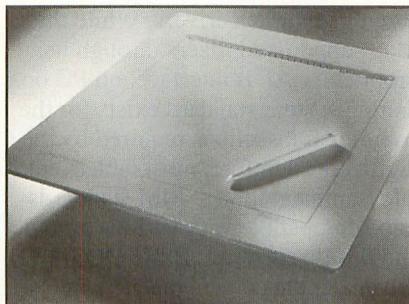
Digitizing tablets have been a favorite of CAD users for many years. They've evolved to offer mouse users and computer graphics artists a more-natural interactive environment with their desktops. Digitizers first attracted CAD users, giving them a customizable extension of their work environment through templates—active buttons or areas that activated menu functions or preprogrammed macros when pointed at on the tablet, which saved precious monitor space.



CalComp DrawingBoard III.



Wacom Technology ArtZ high-speed ADB tablet.



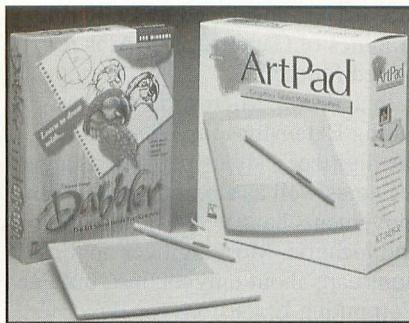
CalComp Drawing Slate.



KYE International Genius EasyPointer Pad.



Kurta PenMouse.



Wacom Technology ArtPad Bundle.



Cirque Glide Point Track Pad.

Recently, tablets have become an electronic version of pencil and paper, greatly benefiting the graphics artist. Equipped with a pen-stylus, the tablet offers more-natural and more-precise freehand drawing capabilities than other input devices. Consisting of a flat tablet and pen-stylus or flat "puck" cursor, the tablet detects the position of the pointing device, usually emitting a coil-generated low-intensity magnetic field, on the tablet's wire grid surface and converting it into x,y coordinates within a fixed coordinate space. The resulting coordinate space is absolute.

The center of the tablet is always the center of the drawing space. Moving to the edge of the tablet moves the cursor to the edge of the drawing space.

Since some of today's software requires just such precision coordinate space, a tablet becomes a highly accurate input tool. Rather than entering numeric coordinates or settling for approximate locations identified on a relatively low-resolution video monitor, you can use a tablet to precisely identify or create specific points by pointing on the tablet.

Designers find tablets handy for working out conceptual ideas. Sketching on the surface of a tablet with a stylus is more-natural than using the

geometric-coordinate functions of some software that support freehand sketching. Better yet, digitized sketches start out in editable vector form, enabling fine-tuning into final technical or production drawings with relative ease.

Graphics artists benefit from pen pointers over mice for translating ideas into computerized form. CalComp, Kurta, Summagraphics and Wacom Technology offer special pressure-sensitive pen-stylus designed for just this. When used with a supported paint or drawing program, such as *Fractal Design Painter*, a pressure-sensitive pen can emulate the range of effects possible with pen, pencil, brush and charcoal. A cordless pen stylus gives the computer artist even more physical freedom by offering movement with the fluidity of traditional brushes and pencils.

CalComp, Summagraphics, Kurta and Wacom tablets respond to pressure by modulating the electrical signal sent from pen to tablet. The best measure for this is the tablet's ability to handle pressure data—the number of levels it records. Wacom's ArtZ offers 120 levels of pen pressure-sensitivity (lpps), whereas CalComp's DrawingBoard III and DrawingSlate, Hitachi's Multipad, Summagraphics

SummaSketch FX, Kurta's XGT and Wacom's ArtPad, UD-1218 and UD-1825 offer 256 lpps. As this feature becomes more widely desired by graphics artists, look for more-sophisticated pen-pressure sensitivity within graphic-arts software to appear.

A pen-stylus is best for sketching and freehand drawing. For precision digitizing and geometry creation, a flat "puck" cursor with crosshairs is preferred, permitting you to identify and lock in points precisely on the tracing surface. "Puck" cursors can offer up to 16 programmable buttons, while pens are generally limited to one or two buttons.

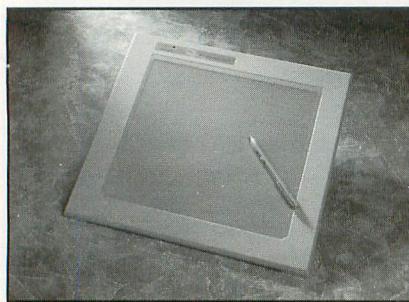
Tablets usually come with a variety of pointer options. CalComp's DrawingBoard III is perhaps the most prolific. You can choose from 10 stylus and cursors. A choice of three or four options is more common.

For general-purpose use, an accuracy (acc) of 0.02" and resolution of 1,000 lines per inch (lpi) are sufficient. The accuracy of a tablet is the degree to which the physical point marked by the cursor or stylus matches the corresponding point within the electronic coordinate space (wire grid on tablet surface).

Resolution is a measure of how many of these points the circuitry can



Kurta XFT family of tablets.



Summagraphics SummaSketch FX Tablet.

distinguish in an inch. A tablet can't be more accurate than its resolution permits. However, accuracy can be degraded by factors like temperature variations. The proximity (prox) for a puck or pen of 0.5" permits accurate tracing through documents up to 0.5" thick.

Tablets usually attach to a computer through a serial port, which permits the required bidirectional communication according to the RS-232 specification. Only two tablets—GTCO Ultima and Numonics GraphicMaster II—draw power from the serial port. The rest employ a separate power source, either built-in or external. Mac users input data and draw power typically from the Apple Desktop Bus (ADB) interface port.

All tablets, except the Scriptel RDT-1212, have smooth opaque plastic surfaces that are fine for most applications. If you do a lot of tracing, a tablet with an electrostatic surface, which uses static electricity to cling the paper while you trace, is recommended. Transparent tablets, such as the Scriptel unit, let you trace from transparencies and x-rays and back-light detailed images.

Tablets transmit location data to a computer in either ASCII or binary format. Getting applications to recog-

nize this requires drivers. While the Mac supports digitizers through its proprietary ADB interface, no PC operating system standard exists for the complex transactions required by the digitizer. Therefore, most tablets emulate Summagraphics' MM standards to be compatible with various graphic and design software. Basic DOS-level drivers let the cursor emulate a mouse.

To take full advantage of the tablet, a real and protected mode Autodesk Device Interface (ADI) driver and/or a *Windows* WinTab extended interface driver, developed by LCS Telegraphics of Cambridge, MA, is required for the PC.

In addition, Microsoft Pen Computing Extensions for *Windows* lets the digitizer's stylus perform as a gesturing as well as a pointing tool. Pen movements have velocity, direction and location. Most digitizer applications care about only the last, but Pen Computing Extensions for *Windows* uses direction information to create a set of standard "gestures" that are meaningful. For instance, moving the pen so as to "scratch out" existing text is interpreted as a delete command.

Most tablets come with utilities or built-in routines that permit adjustment of the size of the digitizing area. This enables you to map the absolute display area to a small portion of the tablet, leaving the rest available for template buttons. Look for software that permits easy re-programming of the tablet.

What follows is a thumbnail view of some small-format tablets. Active-areas range from approximately 6" X 8" to 18" X 25". Larger tablets are available from most of the same vendors. They're small enough to fit on a desktop and are precise enough for sketching and digitizing drawings. Most are based on electromagnetic technology in which a grid of wires under the tablet's hard drawing surface detects the position of a coil inside a movable cursor or pen. Scriptel and GTCO products rely on the less-common resistive electrostatic method.

#### CalComp, Inc.

DrawingBoard III; DrawingSlate; DrawingBoard III: 12" X 12" (\$495), 12" X 18" (\$795), 18" X 24" (\$1,145); acc: 0.005"; lpi: 2,500; four- and 16-button puck prox: 1"; pen prox: 0.4"; lpps: 256; tracking: 200 p/s; ADI, DOS, *Windows* Solaris drivers; cordless versions \$150 extra. Draw-

ingSlate: 6" X 9" w/pressure-pen (\$395), A12" X 12" without pressure-pen (\$395) and B18" X 12" (\$595); acc: 0.001"; lpi: 1,270; pen prox: 0.4"; lpps: 256; tracking: 200 p/s; ADI, DOS and *Windows* drivers. Pressure pen packages for A and B tablets are \$200 extra.

#### GTCO Corp.

Ultima 12" X 18" (\$599); acc: 0.01"; lpi: 1,000; 16-button puck prox: 0.5"; pen prox: 0.3"; tracking: 120 p/s; ADI, DOS and *Windows* drivers. Powered through serial port.

#### Hitachi Corp.

Multipad: 6" X 9" (\$249); lpi: 2,540; cordless pen; lpps: 256; ADI, DOS and WinTab drivers.

#### Kurta Corp.

XGT: 6" X 8" (\$399; Mac: \$425); acc: 0.005; lpi: 1,270; cordless pen; lpps: 256; tracking: 178 p/s; ADI, DOS and WinTab drivers.

XGT 12" X 12" (\$575; Mac: \$595), 12" X 18" (\$915; Mac: \$965); acc: 0.01"; lpi: 2,540; four- or 16-button puck prox: 1"; pen prox: 0.5"; lpps: 256; tracking: 200 p/s; ADI, DOS and WinTab drivers.

#### Numonics Corp.

GraphicMaster II: 12" X 12" (\$495); acc: 0.01"; lpi: 5,000; four-button puck prox: 0.4"; pen prox: 0.4"; tracking: 160 p/s; ADI, DOS and *Windows* drivers. Powered through serial port.

#### Scriptel Corp.

RDT-1212: 12" X 12" (\$1,345), 12" X 18" (\$1,559); acc: 0.01"; lpi: 1,000; four-button puck prox: 0.3"; pen prox: 0.3"; tracking: 200 p/s; ADI, DOS and *Windows* drivers. Features a transparent tablet surface.

#### Summagraphics Corp.

SummaSketch III: 6" X 9" (\$449), 12" X 12" (\$599), 12" X 18" (\$999); acc: 0.01"; lpi: 2,540; four- or 16-button puck prox: 0.5"; pen prox: 0.5"; tracking: 114 p/s; ADI, DOS and WinTab drivers.

SummaSketch FX: 12" X 12" (\$649), 12" X 18" (\$1,149); acc: 0.01"; lpi: 2,540; pen prox: 0.5"; lpps: 256; tracking: 114 p/s; ADI, DOS and WinTab drivers.

#### Wacom Technology Corp.

ArtZ: 6" X 8" (PC: \$499; Mac: \$449); acc: 0.006"; lpi: 1,270; four-button puck prox: 0.3"; cordless pen prox: 0.2"; lpps: 120; tracking: 205 p/s; DOS and *Windows* drivers, *Fractal Design Painter*.

UD 12" X 12" (\$749); acc: 0.006"; lpi: 1,270; four-button puck prox: 0.3"; pen prox: 0.2"; lpps: 120; tracking: 205 p/s; ADI, DOS and *Windows* drivers, cordless pen.

UD 12" x 18" (\$995) and 18" x 25" (\$2,795); acc: 0.006"; lpi: 2,540; four-button puck prox: 0.3"; pen prox: 0.2"; lpps: 256; tracking: 205 p/s; ADI, DOS and Windows drivers. Opaque and transparent tablets available.

Recently, there has been a growing market for small, compact drawing pads that offer a 4" x 5" work area with a 6" x 7" footprint for desktop-PC users. These can also substitute for a mouse and even come with pressure-sensitive pens. Here's a brief list of such devices.

#### Acecad, Inc.

Acecat II: 5" x 5" (PC: \$129; Mac: \$149); acc: 0.01"; lpi: 2,000; pen prox: 0.27"; tracking: 128 p/s; ADI, DOS and WinTab drivers and corded pen.

#### Kurta Corp.

PenMouse: 4" x 5" (\$249); acc: .015"; lpi: 1,016; cordless pen; tracking: 120 p/s; ADI, DOS and WinTab drivers with *Fractal Design Dabbler* software.

#### KYE International

Genius EasyPainter: 5" x 5" (\$149); acc: 0.01"; lpi: 1,016; corded pen prox: 0.05"; ADI, DOS and WinTab drivers with *PC PaintBrush* software.

#### Wacom Corp.

ArtPad 4" x 5" (\$199); acc: 0.02"; lpi: 2,540; cordless pen prox: 0.05"; lpps: 256; tracking: 205 p/s; DOS and WinTab drivers with *Fractal Design Dabbler* software.

Creative Labs' AeroDuet features a wireless pen and mouse based on the company's FreePoint infrared technology. The \$149 AeroPen, \$149 AeroMouse and \$199 AeroDuet have infrared receivers that connect to a PC's serial port. The receiver module processes the infrared signal from the AeroPen and/or AeroMouse hand-held transmitters, calculating the x-, y- and z-axis locations to permit the Pen or Mouse to operate above the desktop in a 3D workspace.

Included *Aero Control Panel* software lets you customize the virtual work area and configure for maximum productivity. You can switch between pen and tablet modes, set automatic detection of the hand-held device, scale the size of the work area, set cursor size and performance characteristics and switch from horizontal to vertical 2D mode for use in presentation

and PC-generated slide shows.

The hand-held units operate on two AAA cells. The AeroDuet package includes *Kai's Power Tools*, *Digital Morph*, *Spectre VR* and a 3D version of *Fractal Design Dabbler* software.

#### Writing Pads

There's a developing market for writing pads that aren't as sensitive as digitizer tablets. The writing pad uses Microsoft's Pen Computing Extensions for *Windows* to recognize handwriting. So you don't need a keyboard to type in forms, take notes and write documents.

These pads let you point, write, draw and navigate in *Windows* 3.1 applications. You can execute all mouse functions and write directly in *Windows* applications, rather than having to jump between keyboard and mouse. More to the point, *Windows for Pen Computing* is portable. Therefore, you can work standing up or walking around—any way that fits your needs. The pads are designed to be comfortable for both left- and right-handed users and usually plug into an available serial port on a PC.

Inforite's \$379 MP100 Writing Pad with *Rite-Expression Annotation* software utilizes the same pressure-sensitive pad technology as the tablet to input such handwritten data as signatures, notations, drawings, etc., directly into *Windows* 3.1, *Word* 6.0, *Ami Pro* 3.01, *Excel* 4, *WordPerfect* 6.0, *Lotus 1-2-3* 2.4/3.0 and *Quattro Pro* 4.0 documents. It features 1,024 X 1,024-point resolution and an active pad area of 2 1/4" X 4". The MP100 is available without *Rite-Expressions* for \$299. It connects to a serial port and can substitute as a mouse.

Communication Intelligence introduces desktop pen computing through *MachHandwriter* and *Handwriter for Windows* (\$399) that enable mouse-replacement as a natural complement to a keyboard. It includes a Ypad note-taker with a thin tablet, cordless electronic pen, *Windows for Pen Computing* Extensions and handwriting-recognition software. A Signature Sentinel signature-protected screen saver is also included and demonstrates a use for the company's *Dynamic Signature Verification* software that lets you restrict access to your computer using your signature instead

of a password. A pressure-sensitive pen stylus is available for \$129.

#### Touch Screens

The popularity of interactive multimedia systems has placed the touch screen solidly in the alternative-input-device category. If you've used bank ATMs, sales terminals, public information kiosks, store and museum displays, interactive training and trade show presentations, you're familiar with the touch screen.

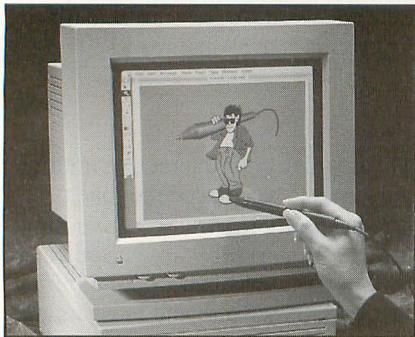
Because most touch screens are designed to emulate a mouse, any application that works with mouse input should be able to handle a touch screen. Be warned, though, that touch screen resolution generally doesn't approach that of a mouse, primarily because finger touches aren't as precise and also because of limitations in touch screen mechanics.

Touch Screens are available in three main configurations that include clip-on frames, dealer installed "invasive" add-on frames for user-supplied monitors and touch screens integrated into the monitors. MicroTouch Systems also offers a unique technology that turns almost any video monitor into a touch screen by placing it on a force-sensing pad. Add-on frames, whether user or dealer installed, typically cost between \$500 and \$1,500, depending on monitor size and touch screen technology.

Integrated touch screen systems carry a greater price premium, but monitor choices are limited. Surprisingly, only two major monitor manufacturers—Sony and Philips—are in the touch screen business. Touch screen vendors are made up of small and growing independent firms.

Five major technologies are used in touch screen units. These are resistive-sensor overlay membrane, scanning infrared, surface acoustic wave, capacitive and force-vector. The first four rely on fitting a frame around the edges of a video monitor, sending out a signal that's affected by touch and then interpreting and translating the signal for the computer's operating system.

Resistive-sensor overlay membranes are one of the oldest and most widespread technologies used by such vendors as Elo Touchsystems, Troll Technology and several smaller man-



FTG Pen Direct

ufacturers. They have dual thin transparent metal layers that form closed circuits when touched (pressed together). Since they rely on an electro-mechanical system, they're more prone to wear and tear than most systems. However, they are relatively inexpensive, exhibit resolution up to 4,096 X 4,096 touch points and have fast response times of around 13 ms.

Scanning infrared technology is used primarily by Carroll Touch. In this system, a grid of infrared beams is transmitted from and received by a bezel that surrounds the screen. When the screen is touched, the grid is interrupted and coordinates are calculated. Advantages of this system are that a membrane or glass need be placed over the monitor and scratch and water resistance. Consequently, the monitor glass is quite durable. Infrared bezels can even be gasket-sealed for outdoor conditions.

Surface acoustic wave (SAW) technology, developed by Elo Touchsystems, is similar to infrared in that a grid of acoustic waves is monitored for interruption. The acoustic waves are transmitted through a glass overlay instead of the air.

SAW is one of the few technologies that can detect z-axis information (256 pressure levels). This pressure data can be used by some authoring and paint programs. The glass transmits 90% light and has a high scratch resistance, although it's vulnerable to poking. While slightly better than infrared, SAW usually has relatively low touch resolution and response time.

Capacitive technology, used largely by MicroTouch, involves a glass overlay with a thin-film metallic coating and a protective sealer. A low-voltage field runs through the coating and has sensors that recognize a finger touch,

since the human body acts as a capacitor. Problems can arise when thick gloves or non-conductive stylus are used. Latex gloves work okay.

Though earlier capacitive screens were vulnerable to scratching, newer coatings applied by MicroTouch have reduced this problem. Gasket-sealed units are available for harsh environments. Light transmission is about 92%, and capacitive screens have fast response times and high resolutions up to 1,024 X 1,024 touch points. They're also relatively inexpensive.

MicroTouch has recently acquired Visage's force-vector technology, which uses an under-monitor pad to sense pressure in three dimensions. Surprisingly resistant to shocks and vibrations, the system constantly recalibrates itself to the ambient noise level of vibrations. It can sense up to 256 levels of pressure in the z-axis dimension, but the primary advantages of this system are its ability to use virtually any video monitor and the durability associated with no overlay on the monitor. Light transmission is 100%, and gloved hands and stylus work well. Main drawbacks are somewhat low resolution and slow response time. It's also more expensive than resistive and infrared systems.

Depending upon your application, look for fast response times (capacitive screens, at 8 ms, are the best, with SAW and infrared screens at 20 to 40 ms being the slowest), durability (resistive screens are more prone to wear and tear than others), high resolution (resistive screens are the best) and resistance to the elements (some units can be sealed for outdoor installations).

On the PC platform, touch screen communication is typically through a bus port on the motherboard or an available serial port. On the Mac, it's through the ADB (Automatic Device Bus) port.

FTG Data Systems has an alternative to touch screen technology in its Pen Direct for Windows (\$298) that brings pen computing technology to the PC without forcing you to buy special video monitors or tablets. It contains a pen and interface package that lets the Windows user manipulate items directly on the monitor's screen using a special pen. In the Windows environment, you simply touch the screen with the pen to pull down

menus, select functions and draw or write directly on the screen.

PenDirect for Windows also lets you easily communicate in a conferencing situation by using direct on-screen input. You can highlight important points and hand-write messages directly on the screen, enhancing desktop conferencing and quick collaboration on projects.

PenDirect quickly senses light from the monitor to determine its position on the screen and works at pixel-level accuracy, at resolutions as great as 1,280 X 1,024. The package includes a light pen, an external interface that connects through a keyboard or mouse port, Microsoft Pen Extensions for Windows, FutureLab's *Talk Show* conferencing software and *PenDirect* software. It's also available for the Mac for \$498 and attaches to the Apple Desktop Bus, eliminating the need for an ac power adapter.

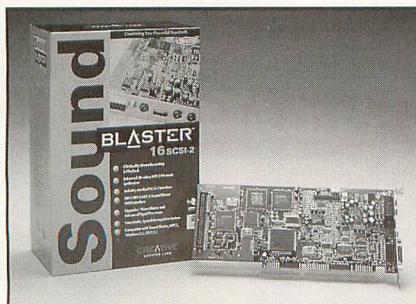
## Scanners & OCR

In the November/December 1994 issue of *MicroComputer Journal*, I noted that the use of scanners, combined with optical-character-recognition (OCR) software, can take away the many hours of hand typing of documents. Vendors like Caere, Calera Recognition Systems and Xerox have improved the accuracy of their products and certainly offer relief from having to enter documents from a keyboard. The article outlines many of the scanner hardware and software products available and how they can be put to effective use.

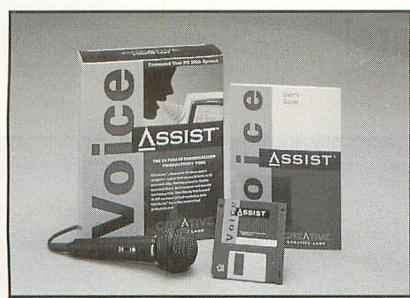
## Voice Recognition

All of the alternative-input devices I've discussed so far involve inputting data or issuing commands to a computer using your hands in one way or another. The effect is to vary the way we use our hands and fingers to input data to decrease exposure to the repetitive or cumulative stress and/or trauma that can result from extended computer use. Other ways are being developed to input to a computer without relying on the use of hands.

The communications technologies of today are converging with personal computing to offer more-natural input facilities for PCs. Vendors are developing voice-recognition software that



Creative Labs Sound Blaster 16 SCSI-2.



Creative Labs VoiceAssist.

should ideally understand voice input as well as we humans understand the spoken word. Anyone should be able to use it, no matter how noisy the background or how slurred words are vocalized.

Software available today must be trained to the user's voice, making it speaker-dependent. Adding to the problem, users must speak distinctly, with a pause between each word, in discrete words for recognition to take place.

Today's voice-recognition software breaks down into two types: voice-command programs in which the computer recognizes and responds to individual commands and voice-dictation programs that can recognize continuous speech and translate it into usable text files.

**• Voice-Command Programs.** These can cost less than \$100 and are usually compatible with the Creative Labs Sound Blaster sound-card technology. Some even come bundled with sound cards and multimedia systems. Voice-command programs typically translate sound bites that are the same as application menu commands that would be given normally by dragging and clicking a mouse or typing a keyboard command. Usually, the software must be trained to the user's voice for each command.

Digital Soup's \$129 *Rover* runs on 80386 and 80486 Windows 3.1 systems equipped with a Sound Blaster or Pro Audio Spectrum sound card, pointing device and microphone. It's speaker-dependent and discrete-word-based and will let you create a vocabulary of commands for any Windows application. While *Rover* can't capture menu commands from applications, you can train it to recognize the commands you use by vocalizing them into the microphone and then typing in their names.

*Rover* comes with 49 Windows commands that you have to link to the applications with which you wish to use voice command. Background-noise filtering is done by trial-and-error, which can add to the overall time-consuming effort needed to get it to finally follow orders.

Interactive Products' \$79.95 *JustVoice* offers speaker-dependent voice command and control of DOS and Windows applications. For Windows, you need at least a 25-MHz 80386 that's MPC Level 1-compliant, while the DOS version can work on an 80286 system with 640K of RAM and a Sound Blaster- or Sound Master-compatible sound card.

You must spend some time with *JustVoice* to train it to recognize your voice and the commands you wish to use. The DOS version comes with a voice-enabled menu system that launches standard DOS applications and, at the same time, ensures that the related command vocabulary is activated. This version supports multiple users and three sub-menu levels.

Microsoft's Windows Sound System 2.0 includes *Voice Pilot* voice-recognition software, *Quick Recorder* for sound compression, a Sound Editor, a ProofReader for converting any Windows text to speech, Voice Wizards to easily create your own personalized voice commands and a Sound Finder to locate files for incorporating sound and/or voice and icons in OLE 2.0 clients. As many as 256 commands can be active at once, with any number possible from a set of applications.

A built-in vocabulary covers 15 applications, including *Excel*, *PowerPoint*, *Word for Windows*, *Works for Windows*, *WordPerfect for Windows*, *PageMaker* and *Lotus 1-2-3 for Windows*. Working with the built-in Microsoft software, the training is much

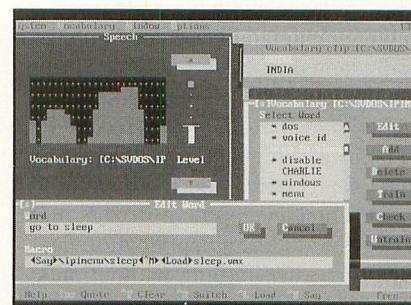
more efficient and accurate. *Sound System* is available with a microphone for \$79 or with a 16-bit sound card, microphone and headphones for \$219. It needs at least an 80386SX computer with 2M of RAM and Windows 3.1.

Verbex Voice System's \$99 *Listen for Windows* 2.0 continuous speech-recognition software comes with more than 16,000 commands for the most-popular Windows programs, including some games. It can learn voice commands for 12 well-known programs, including *AutoCAD 12*, *Quicken* and the software suites from Lotus and Microsoft. It's speaker-independent in that you don't have to teach it to recognize your voice. However, you can teach it if this becomes necessary.

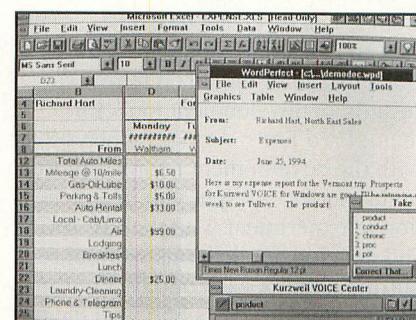
*Listen* requires a minimum of a 25-MHz 80486SX PC with 4M of RAM and a Sound Blaster-compatible card with Windows 3.1 wave-driver cable to record at an 11,025-Hz sampling rate. A bundle with a headset-style or mount-able microphone is available for \$139.

Chances are that if you have a Creative Labs Sound Blaster card, you have the *VoiceAssist* speaker-dependent, discrete word-based recognizer and *TextAssist*. With each priced individually at \$99, it's the least-ex-

(Continued on page 110)



Interactive Products *JustVoice* for DOS screen.



Kurzweil Voice for Windows screen shot.

# A PIC16C71 Development System

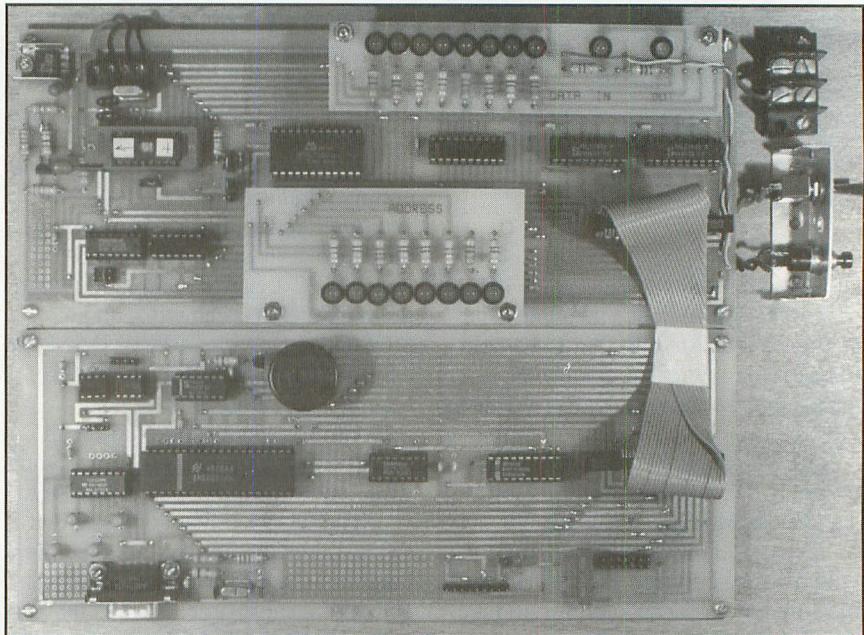
## Part 1

### Building a PIC16C71 Development Board

The PIC16C71 microcontroller was fully described by Fred Eady in the July/August 1994 issue of *MicroComputer Journal*, in which Fred also included instructions for building an inexpensive programmer. In the two-part series that begins with this issue, I'll explain how to build two Development Boards that implement a latched address bus, 1K byte of RAM, an I/O bus, a keypad, an LCD panel, a UART and a piezoelectric buzzer. I'll also detail how to program the PIC16C71 to control all these devices.

Both boards were designed specifically for development purposes. They're large and have wide traces, and they can readily be configured and adapted to support a wide variety of applications. The main board is designed to use a ZIF socket for the PIC to facilitate frequent reprogramming that usually occurs during development. The Development Boards make it possible to test an application design and programming without making a printed-circuit board or the hassle of working up a complex breadboarding setup.

Since the PIC family of microcontrollers can be characterized as small, fast and inexpensive devices, most hobbyists aren't inclined to invest heavily in development tools for them. Fred Eady's programmer, along with the development boards I present in this series, will put you in a position to experiment with the PIC16C71 and develop applications without requiring a major cash outlay. Fred's programmer kit costs \$50, and the estimated cost of parts for each board I'll be presenting is \$50. You also



Display daughterboards mount in piggy-back fashion on Main Board via machine hardware and spacers.

need an LCD panel, a keypad and at least two PIC16C71s with EPROM, for a total cost of about \$250. Finally, you also need an inexpensive ultraviolet EPROM eraser.

I selected the PIC16C71 for the reason that it's as small and almost inexpensive as the PIC16C54 while having interrupt capability. More importantly, it's less expensive and smaller than its more-capable 28-pin cousins. The boards described here can be used with the PIC16C54 or PIC16C56, provided that the application is limited to its capabilities.

#### Main Board

The schematic diagram for the Main

Board circuitry is shown in Fig. 1. It includes provisions for 256, 512 or 1,024 bytes of static RAM, an eight-bit tristate buffer for external I/O and an eight-bit address bus that's available to external devices. This arrangement lets you connect external devices to the board and selectively enable them via address selection. The tristate buffer assures that the data bus won't be affected by external devices, except when the PIC is engaged in data transfer. This prevents possible data errors and damage to the PIC and RAM chips.

The RA<2:0> lines are reserved for controlling access to RAM and the I/O buffer. RA<4:3> can be jumpered

to select the RAM page (256-byte block), or either jumper can be connected to disable the RAM pages that it controls, freeing the line for other use. These two lines are available on the external device connector for use as dictated by the application.

The address bus is implemented by 74LS373 octal latch *U2*. The desired address is put on the data bus by the RB register. Then the latch is strobed by making RA<1:0> high for one program cycle while holding RA<2> low.

RAM is implemented by 2,016 x 8 SRAM chip *U3*. Four of the eight pages are disabled by a ground connection at A10 to permit any one of four pages to be selected. Offset within the selected page is determined by the currently latched address.

After latching the address, RAM can be read by making RA<0> high or written by making RA<1> high while holding RA<2> low. All bits of RB must be inputs during a read operation or outputs during a write operation.

The data buffer is implemented by 74LS244 octal tristate buffers *U4* and *U5*. Four each of the inputs and outputs of each chip are tied to the data bus. The other four inputs and outputs are tied to the I/O bus, which is available on the external device connector. Setting RA<0> and RA<2> high enables input and drives IOR low. Setting RA<1> and RA<2> high enables output and drives IOW low.

Jumpers at *J3* through *J6* can be used to configure use of some of the PIC port pins. Jumpering *J3* lets you use RA<3> to page RAM or ground the RAM page selection pin. Jumpering *J4* does the same for RA<4>. If either is an input, it can't be used to page RAM. A jumper at *J5* allows RB<0> to be used as D<0> on the data bus, or D<0> can be jumpered to ground (always zero), leaving RB<0> to be used for another purpose. Jumpering *J6* lets you use RA<2> to select either I/O or RAM and the address latch.

If the application does not use I/O, *J6* can be jumpered to hold the selection line low. If the application doesn't use either the address latch or RAM, *J6* can be jumpered to hold the selection line high. Table 1 is the truth table for the RA<2:0> lines.

A 2716 EPROM chip can be used in place of a RAM chip for *U2*. With an EPROM programmer, you can

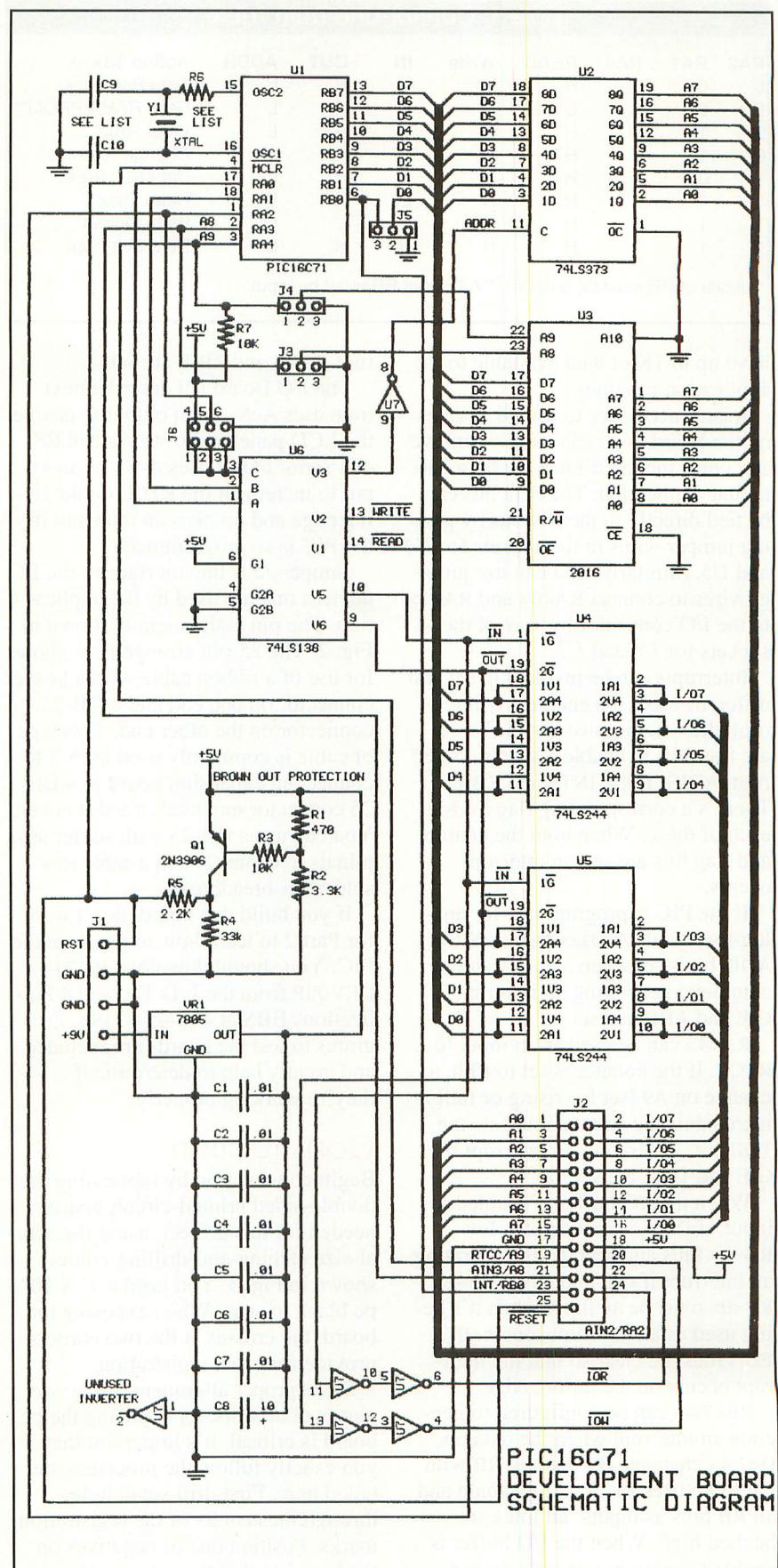


Fig. 1. Complete schematic diagram of PIC16C71 Development Board circuitry.

**Table 1. Control-Line Truth Table**

RA2	RA1	RA0	READ	Write	IN	OUT	ADDR	Action Taken
0	0	0	H	H	H	H	L	Data Bus Free
0	0	1	L	H	H	H	L	Read RAM/EPROM**
0	1	0	H	L	H	H	L	Write RAM*
0	1	1	H	H	H	H	H	Change Address*
1	0	0	H	H	H	H	L	Data Bus Free
1	0	1	H	H	L	H	L	Read Input**
1	1	0	H	H	H	L	L	Write Output*
1	1	1	H	H	H	H	L	Data Bus Free

\*All bits of RB must be output. \*\*All bits of RB must be input.

have up to 1K of data available to the application program.

It isn't necessary to use all devices on the board. You can simply remove any chips that aren't needed by a particular application. The data bus can be tied directly to the I/O bus by placing jumper wires in the sockets for *U4* and *U5*. Similarly, you can use jumper wires to connect RA<0> and RA<1> to the I/O connector by way of the sockets for *U6* and *U2*.

Interrupts can be invoked in several different ways. To enable any interrupt, the GIE bit must be set. There are four bits to enable a specific interrupt: ADIE, TOIE, INTE and RBIE. There's a corresponding flag bit for each of these. When both the enable and flag bits are set, an interrupt occurs.

If the PIC is programmed for analog-to-digital (A/D) conversion, the ADIF bit is set when a conversion is complete, generating an interrupt if GIE and ADIE are set.

RA<4> can be used as an input to RTCC. If the counter is set to FFh, a change on A9 (set for rising or falling) increments the counter and sets the TOIF bit, generating an interrupt if GIE and TOIE are set.

When the I/O buffer is enabled for input, if D<0> is low or goes low, RB<0> falls and sets INTF, generating an interrupt if GIE and INTE are set. RB<0> must be an input when it's being used as an interrupt source. INT-EDG must be clear so that the interrupt occurs on the falling edge.

RB<7:4> can be configured to generate an interrupt when the data on D<7:4> changes. By reading RB with the I/O buffer and RAM disabled and all RB pins as inputs, all lines are latched high. When the I/O buffer is enabled for input, a low on any of D<7:4> sets RBIF, generating an inter-

rupt if GIE and RBIE are set.

The I/O Board I'll describe next time uses A<8> as an output to enable the LCD panel and/or to control RS-485 serial I/O. It uses A<9> as an input to increment the RTCC on the rising edge and invokes an interrupt if the PIC is so programmed.

Jumper J2 is the interface to the I/O devices that are used by the application. The pin assignment is shown in Fig. 2. The 25-pin arrangement allows for use of a ribbon cable with a header connector on one end and a DB-25 connector on the other end. This type of cable is commonly used in PCs to connect an expansion board to a DB-25 connector mounted in a slot cover. You can use a DB-25 with solder terminals to connect such a cable to a solderless breadboard.

If you build this board, don't wait for Part 2 to learn how to program the PIC. You should download PIC71-DEV.ZIP from the E D Technical Publications BBS at 407-454-3198. Programs to test the boards are included and greatly help to determine if they're working properly.

## Construction

Begin construction by fabricating the double-sided printed-circuit boards needed for this project, using the actual-size etching-and-drilling guides shown in Fig. 3. You need a 7" x 10" pc blank to start. When exposing the board, the crosses at the two corners provide for exact registration.

Since proper alignment of the two pieces of artwork for exposing the pc board is critical, it's important that you exactly follow the procedure detailed here. First drill small holes through the centers of the registration marks. Position one of negatives on the board so that the entire pattern is within its boundaries and drill the

J2							
A0	1	●	●	2	I/O7		
A1	3	●	●	4	I/O6		
A2	5	●	●	6	I/O5		
A3	7	●	●	8	I/O4		
A4	9	●	●	10	I/O3		
A5	11	●	●	12	I/O2		
A6	13	●	●	14	I/O1		
A7	15	●	●	16	I/O0		
	+5V	17	●	●	18	GND	
	RTCC/A9	19	●	●	20	IOW	
	AIN3/A8	21	●	●	22	IOR	
	INT/RB0	23	●	●	24	AIN2/RA2	
	RESET	25	●				
J2 PIN ASSIGNMENTS							

**Fig. 2.** Pin assignments for *J2*.

same size holes through the board. Select a bit size that permits small tacks to be used to hold the negatives in position.

Place the pc blank on a wooden surface and tack the negative in position through the holes. Then place window-pane glass over the negative to hold it in intimate contact with the blank. The two holes assure that the negative is correctly oriented for the second exposure.

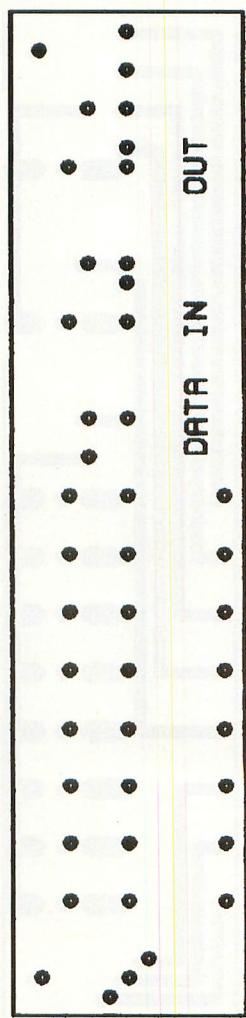
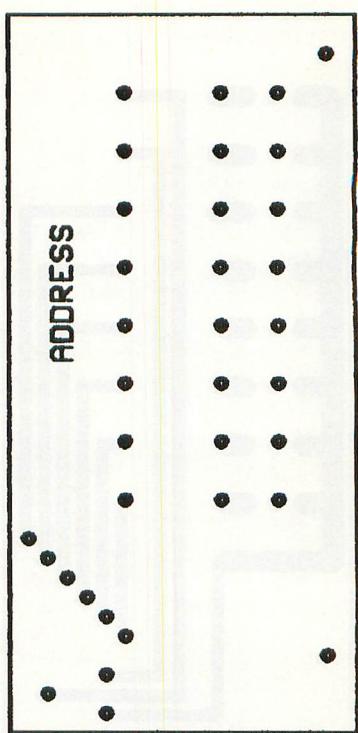
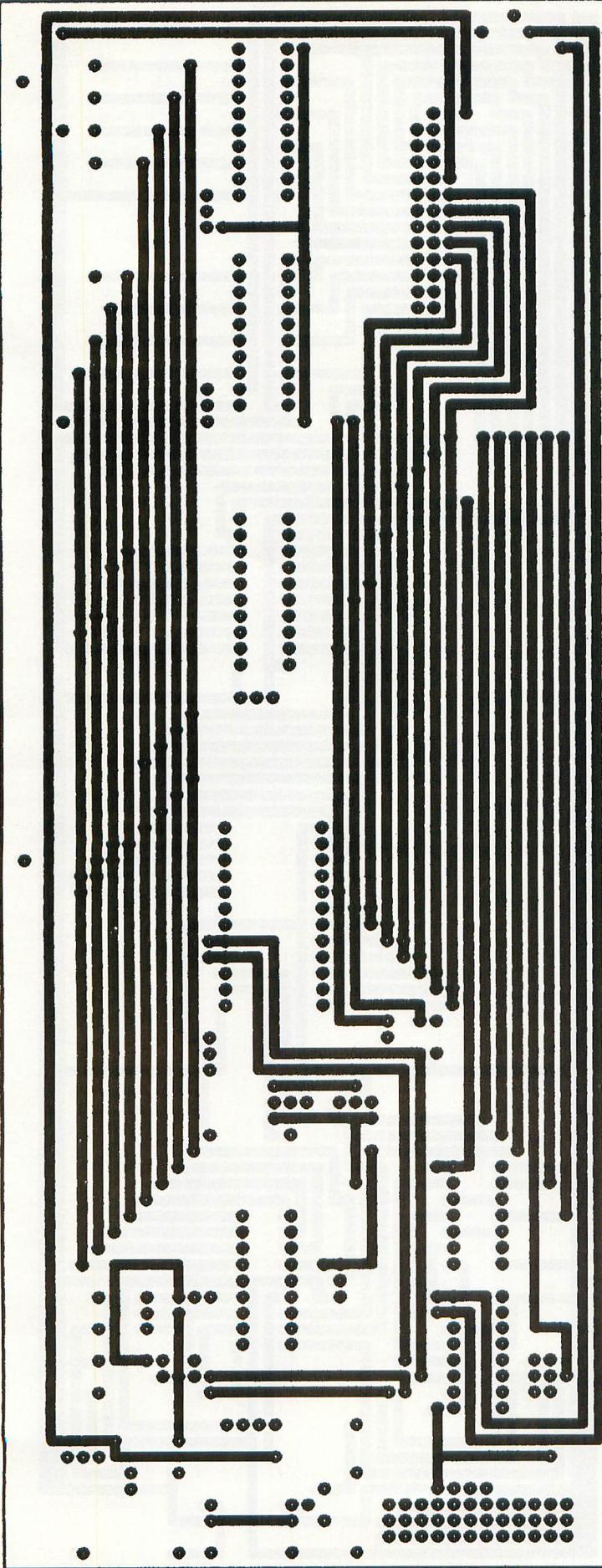
Before etching, enlarge the two holes in the blank and drill two more holes in the other corners with a  $5/16$ " bit. Place  $1/4$ " X 6-32 machine screws in the holes and follow up with nuts to create spacers that will permit the etchant to flow freely under the blank.

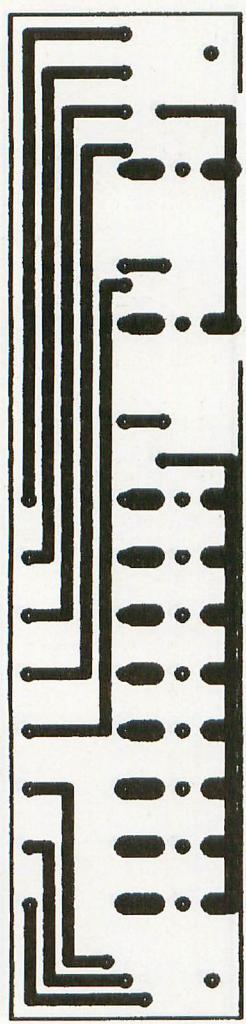
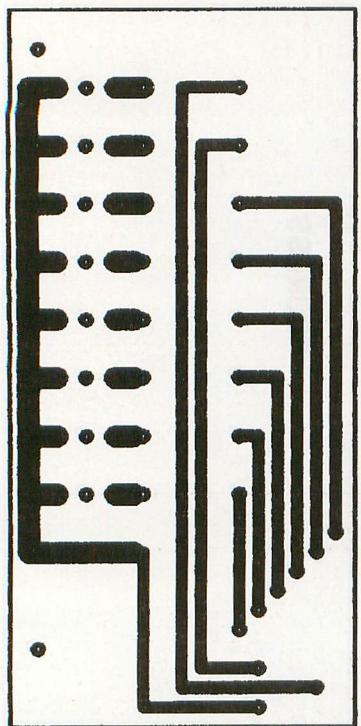
Note that the Fig. 3 patterns provide for two display boards. After etching, you must separate the three boards by cutting along the border lines. Do not connect the display boards to the Main Board until the latter has been fully tested. The display boards mount piggy-back fashion above the Main Board (see lead photo) and cover feed-through pads that might not be well-soldered.

After separating the etched pc boards, you must drill the component-lead/pin holes. A No. 68 bit should accommodate most component leads, except those for VR1 and the headers, which require a larger-size hole.

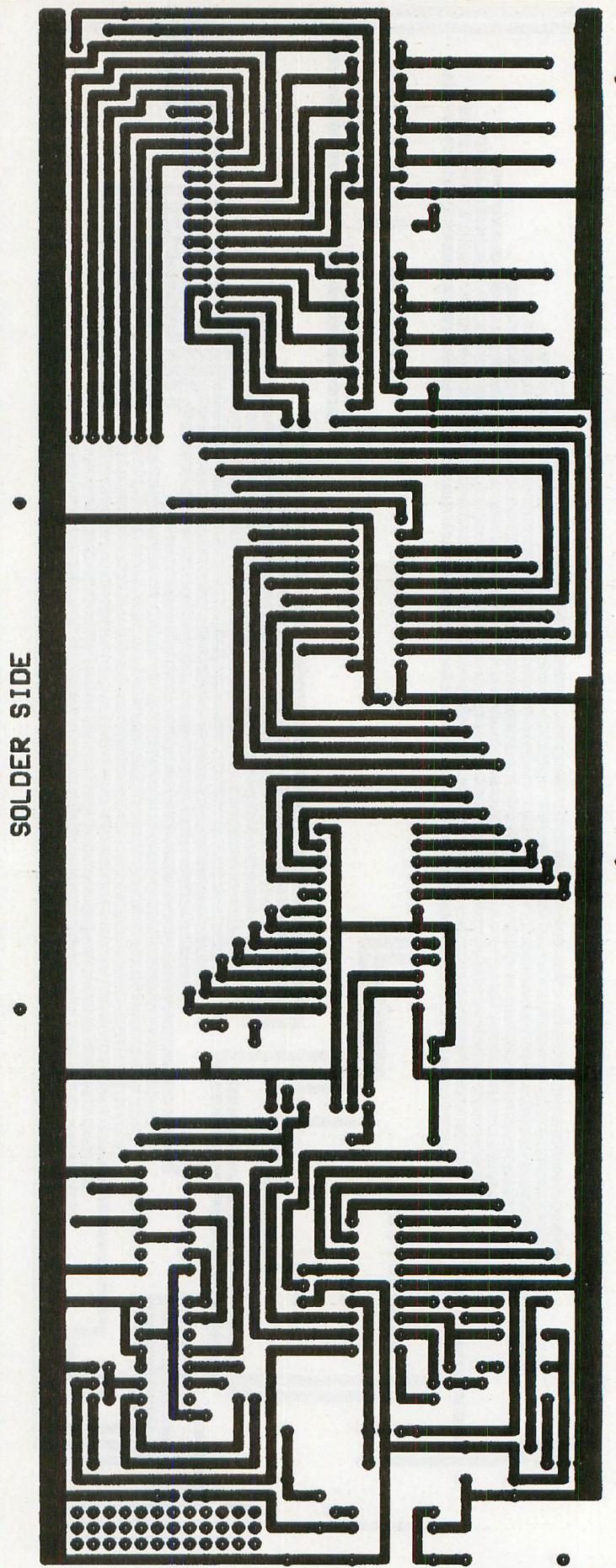
Referring to Fig. 4, populate the Main Board with the various compo-

**Fig. 3.** Actual-size artwork for fabricating double-sided pc boards for project.





SOLDER SIDE



# PIC16C71 DEVELOPMENT BOARD COMPONENT PLACEMENT

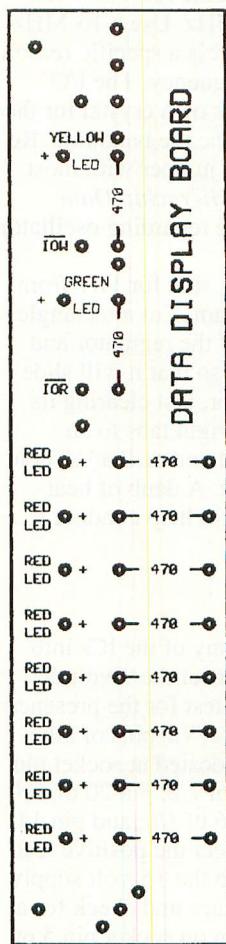
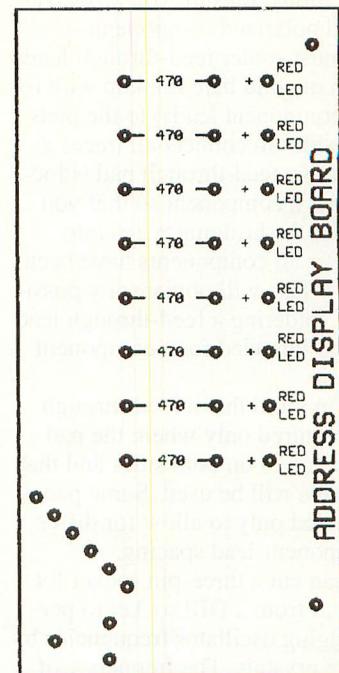
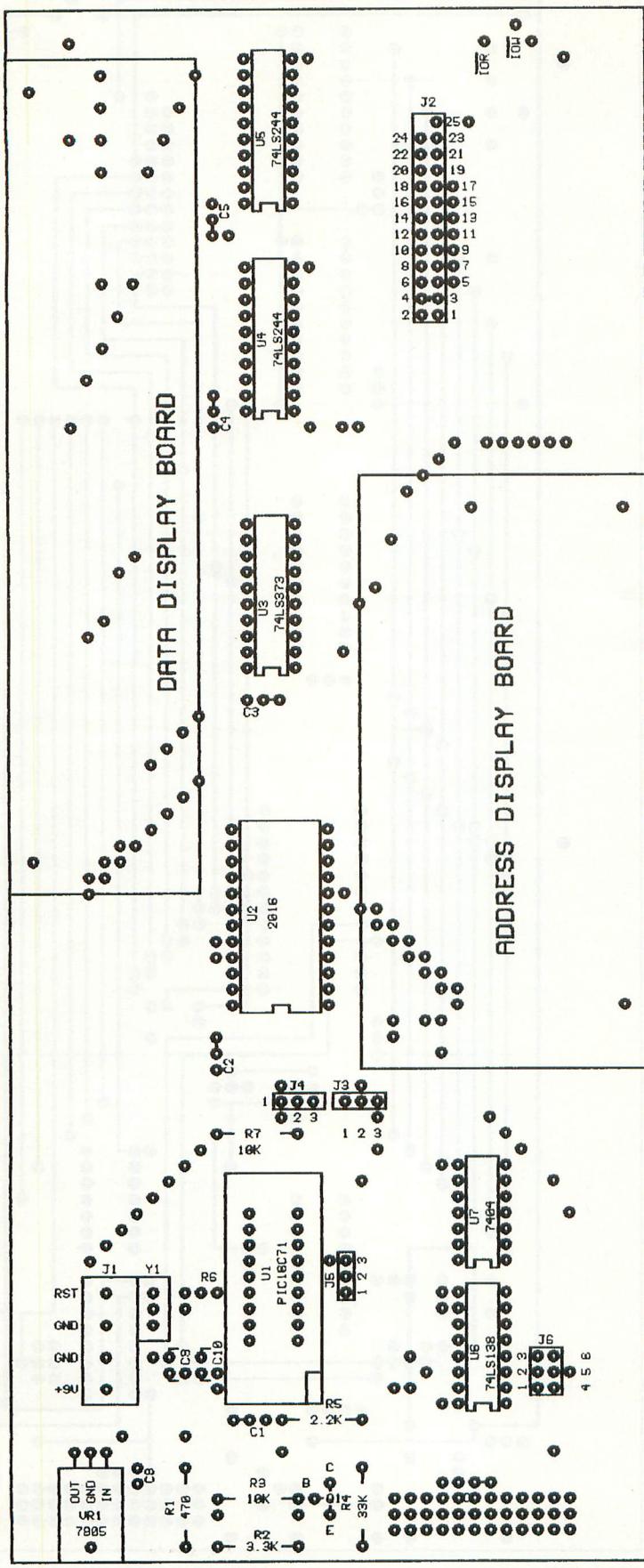


Fig. 4. Wiring guides for pc boards.

nents, installing sockets—not the ICs themselves—at the indicated component locations. Be sure you properly orient all polarized components.

You must solder feed-through leads *made up of solid bare hookup wire* (or cut-off component leads) to the pads on both sides to connect all traces as required. No feed-through pad is located under a component so that you can solder the bridging wires into place *after* all components have been mounted. This will obviate any possibility of soldering a feed-through lead into a pad intended for a component lead or pin.

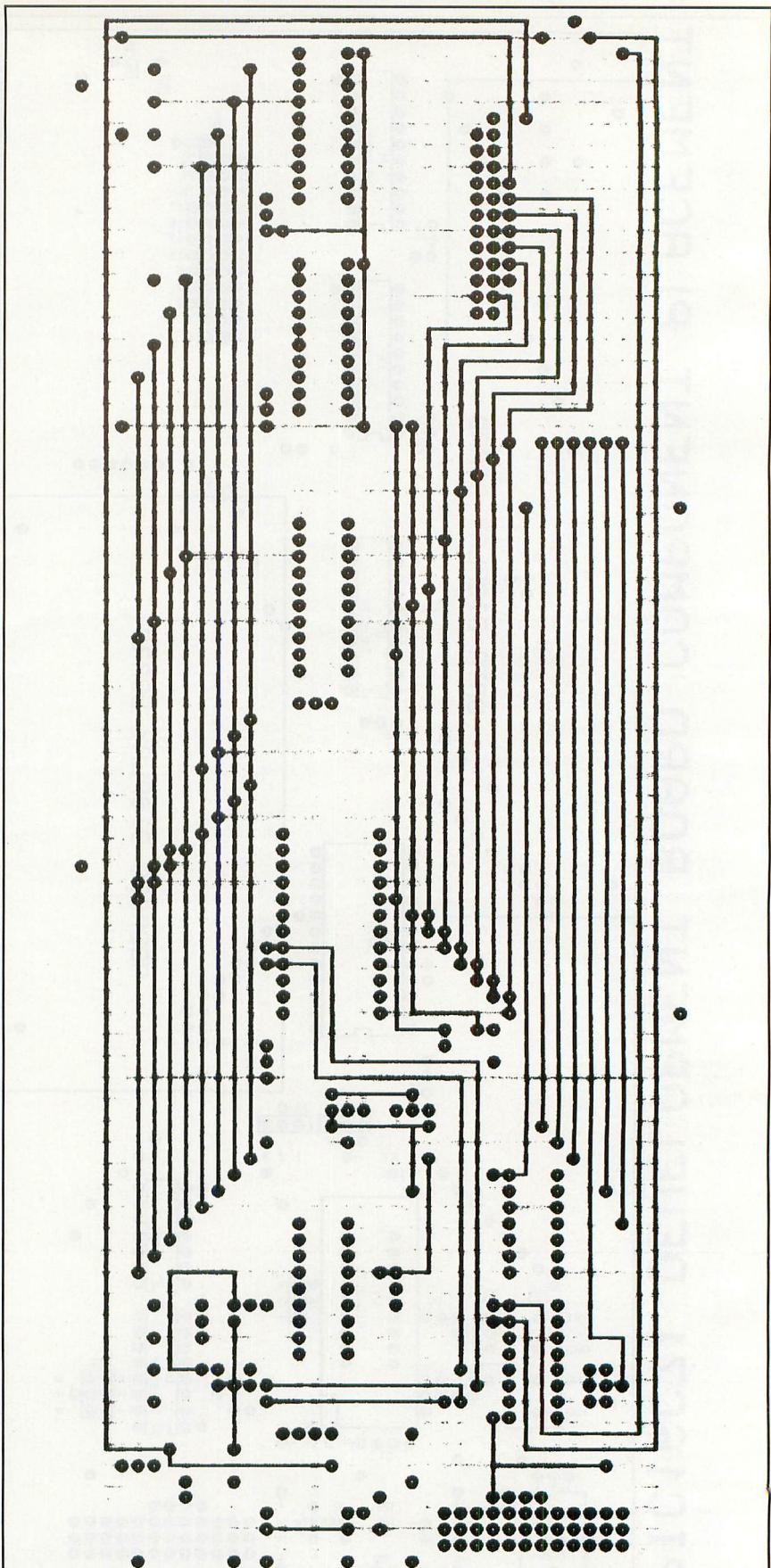
Keep in mind that a feed-through lead is required only where the pad connects traces on both sides and that not all pads will be used. Some pads are intended only to allow for different component-lead spacing.

You can cut a three-pin socket for the crystal from a DIP socket to permit changing oscillator frequencies by changing crystals. The frequency of the crystal or ceramic resonator can be from 4 to 16 MHz. Use a 16-MHz crystal unless there's a specific reason to use a lower frequency. The I/O board will have its own crystal for the UART to determine the baud rate. Resistor R6 can be a jumper with most crystals. See the *Microchip Data Book* for guidance regarding oscillator options.

Fabricate a heat sink for VR1 from thin sheet aluminum. Cut a rectangle to fit the length of the regulator and bend the sides up so that it will slide under the regulator, just clearing its width. Cut the upright tabs to an appropriate height and drill a  $1/8$ " hole for 4-40 hardware. A daub of heat-sink compound will help conduct away the heat.

## Testing

Before plugging any of the ICs into their sockets, connect the 9-volt dc adapter to *J1* and test for the presence of 5 volts at the  $V_{cc}/V_{dd}$  pins of all chips. These are located at socket pin 14 of *U1*; pin 24 of *U2*; pin 20 of *U3*, *U4* and *U5*; pin 16 of *U6*; and pin 14 of *U7*. Then connect the positive lead of the voltmeter to the +5-volt supply at a convenient place and check for a ground connection on socket pin 5 of *U1*; pin 12 of *U2*; pin 10 of *U3*, *U4* and *U5*; pin 8 of *U6*; and pin 7 of *U7*. Make all tests on the socket itself, *not* the solder side of the circuit board.



**Fig. 5.** View of both sides of main board to aid in circuit tracing in event of problems.

## PARTS LIST

### Semiconductors

Q1—2N3906 or equivalent pnp transistor  
U1—PIC16C71 microcontroller  
U2—74LS373 octal latch  
U3—2016 2K x 8 SRAM (150 ns)  
U4, U5—74LS244 octal tristate buffer  
U6—74LS138 3-to-8 decoder  
U7—7404 hex inverter  
VR1—7805 +5-volt regulator (TO-220)

### Capacitors

C1 thru C7—0.01- $\mu$ F disc  
C8—10- $\mu$ F tantalum  
C9, C10—15-pF disc\*

### Resistors (1/4- or 1/2-watt, 5% tolerance)

R1—470 ohms  
R2—3,300 ohms  
R3—10,000 ohms  
R4—33,000 ohms  
R5—2,200 ohms  
R6—see\*

### Miscellaneous

Y1—Crystal\*

Printed-circuit boards; sockets (24-pin DIP for U3; 20-pin DIP for U2, U4, U5; 18-pin DIP for U1; 16-pin ZIF for U6; 14-pin DIP for U7); connectors (4-position PCB connector for J1; double-row 26-pin header for J2; double-row 6-pin header for J6; single-row 3-pin headers for J3, J4, J5); jumper blocks for J3 thru J6; 9-volt, 500-mA dc adapter; power and reset switches (optional); machine hardware; hookup wire; solder; etc.

### For Display Boards

LEDs—16 red; 1 green; 1 yellow (all T1<sup>3/4</sup>)

Holders—18 T1<sup>3/4</sup> snap-in LED type

Resistors—470 ohm (18 each)

\*See *Microchip Databook* for recommended oscillator components. Y1 can be 4-, 8- or 16-MHz crystal or 4- or 8-MHz ceramic resonator; R6 can be a jumper with most crystals or ceramic resonators. If PIC is configured for HS oscillator, 15-pF is the recommended value for C10 and C11.

When programming a PIC, specify fuse options HS D D P. Jumper pins 1 and 2 of J3 and J4, pins 2 and 3 of J5 and pins 2 and 5 of J6. Program a PIC16C71 from PIC16C71.HEX.

With no power applied, plug the PIC into the ZIF socket and a crystal or ceramic resonator into its socket. When power is applied, the potential on pin 15 should be 2.5 volts, indicating that the oscillator is working. Check MCLR at pin 4. If it's less than 4.5 volts, check the brown-out circuit consisting of Q1 and R1 through R5.

With no power applied, plug the remaining chips into their sockets, apply power and check the voltage after each chip is installed. (Make sure each IC is properly oriented and that no pins overhang the sockets or fold under between ICs and sockets.) If you don't obtain a reading of 5 volts, quickly remove power and check the connections to the pins of the chip that caused the problem.

At this point, all data and address bus lines should be low (less than 0.8 volt). IOR and IOW should be high (about 4.5 volts).

When all tests have been run and the board is confirmed to be operating properly, run some diagnostic programs. Program a PIC from ADDRESS.HEX. Apply power and check the voltage on all lines of the data and address buses. They should all read about 2.5 volts. An oscilloscope should display a square-wave pulse train on all data- and address-bus lines, doubling in frequency as you move from higher order to the next lower order.

Program a PIC from OUTPUT.HEX. Apply power and check the voltage on all lines of the data and I/O buses. They should all read about 2.5 volts. An oscilloscope should show a square-wave pulse train on all data bus and I/O bus lines, doubling in frequency as you move from high- to succeeding low-order. Figure 5 shows the traces on both sides of the board.

After all tests have yielded correct results, power down and connect the display boards to the Main Board. To do this, drill 1/8" holes through the pads at the edges of the boards and use 4-40 hardware with spacers to secure the display boards to the main board. Use a twisted-pair cable to connect the green LED to IOR and yellow LED to IOW on the main board near the I/O header. Solder bare leads to the pads on the display boards and feed them through the corresponding pads on the Main Board.

Attach the display boards to the Main Board with screws and spacers. Then solder the connecting leads to the pads on the main board.

Program a PIC from RAMTEST.HEX and plug it into the ZIF socket. When power is applied, all data and address LEDs should light. If an error occurs, the yellow output LED lights, the address display shows the address of the failure and the data display shows the data read from RAM.

## In Conclusion

Once you have the Main Board working, you probably won't want to wait for Part 2 to begin experimenting with it. Connect it to a solderless breadboard and try making some simple programs work. If you have a problem you can't resolve or need any help, call me during Eastern daytime hours at 717-964-3536.

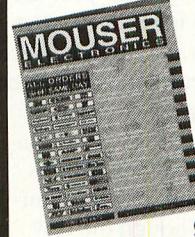
Next time, I'll detail construction of the Auxiliary Board and programming the PIC to control the devices on both boards. You can get camera-ready printouts of the pc-board patterns by calling me or mailing a request to me at PO Box 255, Mt. Gretna, PA 17065. Include a floppy disk of your choice if you want a copy of the program files. ■

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# Introduction to Digital Signal Processing

Why and how DSP chips are now changing PCs and will become standard in personal computing in the future

If you don't have at least one already, you soon will. Digital Signal Processing (DSP) chips are currently one of the hottest and newest computer peripherals and will soon be part of almost every modern desktop computer. Though you won't go out and just buy a DSP chip, you'll find them included on sound cards, modems, telephony products and, eventually, in all video adapters. They should even appear in high-speed disk and tape controllers. In a few years, DSP will be almost as essential to your computer as your keyboard and video-monitor screen.

To understand what DSP chips do, and why they'll be so important, you need to understand a little of the history of computer peripherals. DSPs are appearing first in sound cards, which is a good place to start.

## Early PC Sound

Sound has been a part of the PC from its inception. IBM engineers probably thought of the small internal speaker with its arcane programming interface as simply a way to communicate error messages to the user. Programmers quickly learned to use the speaker interface and added sounds to serious programs and something akin to music to early games. Though the tiny speakers in many PCs don't lend themselves to high fidelity sound reproduction, clever programming can produce apparent polyphony (multiple tones at once) and even noise that approximate speech.

Historically, complex games, education and entertainment programs and serious music programs that connect a computer to other instruments all demand more than even the cleverest programs could produce through the PC's internal speaker. The first generation of sound cards were meant to fulfill all of these roles. They provided reasonable fidelity, and they had on-board synthesizers and a variety of inputs and outputs.

One of the first popular sound cards was Creative Labs' Sound Blaster. It established a *de-facto* industry standard. As a result of its popularity, other manufacturers, no matter how many advanced features they packed onto their sound cards, had to make sure that their products were "Sound Blaster-compatible." In general, all compatible sound cards ran the same basic software, but each also had features that defined its unique niche in the marketplace.

When *Windows* multimedia extensions appeared, soon after release of *Windows* 3.0, compatibility between sound cards improved. Programmers could write to the *Windows* specifications and know that inconsistencies between sound cards would be smoothed out by installed drivers. In addition, most cards included specialized software that could take advantage of their advanced features.

Only one nagging question remained. Most first-generation audio cards can synthesize sound based on a data stream, play back sounds from a variety of sources and even record

voice and sounds. But their functions were limited by fixed-function hardware. The program interface simply accepted commands from a repertoire that was limited by the electronics on the card.

## Enter DSP

With a first-generation sound card, if you want new features you have to buy a new card. The electronics on the card and acceptable program commands were fixed when the card was designed. The same is true of other signal-processing peripherals, such as modems. Your modem has fixed features, especially communication protocols and speeds. If you have a 2,400-bps modem, for example, you can't make it run at 14,400 bps or faster, no matter what you do or your software does. Its speed and range of transmission protocols are hard-wired into it. If you want to go faster or use a new error-correcting protocol, you have to buy a new modem.

In the past, limitations like the foregoing have been accepted as part of the "upgrade or perish" culture of the computer industry. If you have an early eight-pin dot-matrix printer, a 300-baud modem or an early eight-bit sound card, you probably have relegated them to the closet or trash bin. They really have no place in modern computing.

DSP promises to end, or at least slow down, the rampant obsolescence of many peripherals. A well-designed peripheral based on a DSP chip can

be upgraded to include new features with software instead of a new hardware purchase.

The foregoing, at least, is the great promise of DSP. In addition, DSP-based products should soon be less expensive than those based on hardware and firmware, as DSP chips fall in price and gain in power.

At its heart, one of these new peripherals has a DSP chip, which is a special kind of microprocessor. Theoretically, there isn't much difference between the CPU that runs your computer and a DSP chip. In fact, Intel claims that the Pentium makes an acceptable DSP chip. Also, DEC has claimed that the latest version of its ALPHA CPU should make all DSP chips obsolete. Few engineers and designers in the field agree with either claim.

Much like a numeric microprocessor, a DSP chip is optimized to perform complex floating-point, fixed-point and integer math at very high speeds. But unlike a 387 math-coprocessor chip or the math coprocessor built into 486 and Pentium CPUs, for example, DSPs usually work with numbers that can be represented in 16 or 32 bits, not the 80-bit, high-precision values used by general-purpose numeric coprocessors.

Because of their lower precision, DSPs can be much, much faster than general-purpose CPUs. Many of the most-popular DSP chips are part of Texas Instrument's TMS320 family. A soon-to-be-released member of this family, the TMS320C80, is reputed to be capable of nearly 2,000 MIPS (2-billion instructions per second) on its four internal DSP processors and internal RISC controller. Many newer DSPs can perform the math for which they've been designed faster than a Pentium CPU can.

Okay, so a DSP can do a lot of math very quickly, but how does this make the newest peripherals more flexible? The answer is that DSP chips aren't only math engines; they're also programmable microprocessors. Like the CPU in your computer, a DSP accepts both program instructions and data as input. Any sound card based on a DSP, for example, can not only operate on sound input and generate sound output, it can also manipulate the sound signals in-

ternally in any manner a programmer can devise.

The one real requirement for most DSP applications is that the processor must be fast enough to handle signals in real-time. You don't want a pause between each sound created by your sound card, nor do you want your modem to stop to calculate how it should send the next data bit. If the DSP chip can't keep up with the real world, it's useless for most applications.

For example, many older sound cards have an echo function built into their firmware. They can generate an echo (perhaps of footsteps in a marble hallway) and perhaps adjust the delay (time between echoes) and attenuation (how quickly the echo fades away and becomes inaudible). But few, if any, can generate sound effects based on frequency shifts as part of the echo, making the sound higher or lower in frequency, or echoes with a negative attenuation so that sounds become louder until they reach a maximum volume. You can imagine both kinds of sound, even if you can't conceive a use for them, but first-generation sound cards can't.

With a DSP, if the card can't do something you need it to do, it isn't difficult to add the software required to execute the function to the DSP's function table. At least, it isn't difficult for those who understand how to program the DSP. If you want to create instructions for the DSP yourself, you need a development tool kit for the chip, a compiler for your computer and a fair amount of hardware knowledge.

On the other hand, it will be easy to upgrade the software on your sound card or other DSP peripheral by simply running a program supplied by a manufacturer or even by an advanced amateur. The software can take care of the details of downloading a program to the DSP's program RAM. You won't have to know how to program the DSP to update it, just as you don't have to understand the internal workings of Windows to use it.

## DSP Sound Cards

Conceptually, a first-generation sound card is very simple. A program sends a command over the computer's bus to the card, which captures the com-

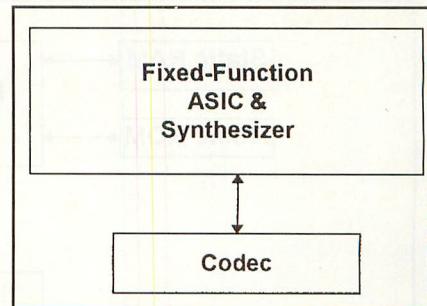


Fig. 1. Traditional sound-card architecture.

mand in an ASIC and, if necessary, creates a sound with a built-in synthesizer, as illustrated in Fig. 1.

A DSP-based sound card is typically more complex and more flexible. Figure 2 is a block diagram based on one popular card that uses Analog Device's ADSP-2115 DSP chip. This card has three important parts: a bus interface ASIC that communicates with the host computer, a 16-bit analog sound interface and a DSP with its associated RAM and music ROM.

It's important for you to understand that almost everything that occurs on the DSP peripheral is based on software and not hardware. If you don't like the card's music synthesis, you can re-program it, and if you want to change the way it samples and digitizes voice input, you can re-program it for this.

Another advantage of a DSP-based sound card is that it can appear to be a Sound Blaster (or any other first-generation sound card) to your software. With appropriate on-board software, it can respond to Sound Blaster commands, just as any other sound card would. In addition, with a fast change of on-board programming, it can configure itself to work like virtually any other sound card.

Almost every sound card manufacturer now has DSP-based cards on the market. Often, the prices for such cards are greater than for the older, first-generation cards. But prices should fall soon, especially as manufacturers deplete their inventories of older cards and recover development costs for the newer cards.

## Other DSP Applications

Sound cards are the most-visible but

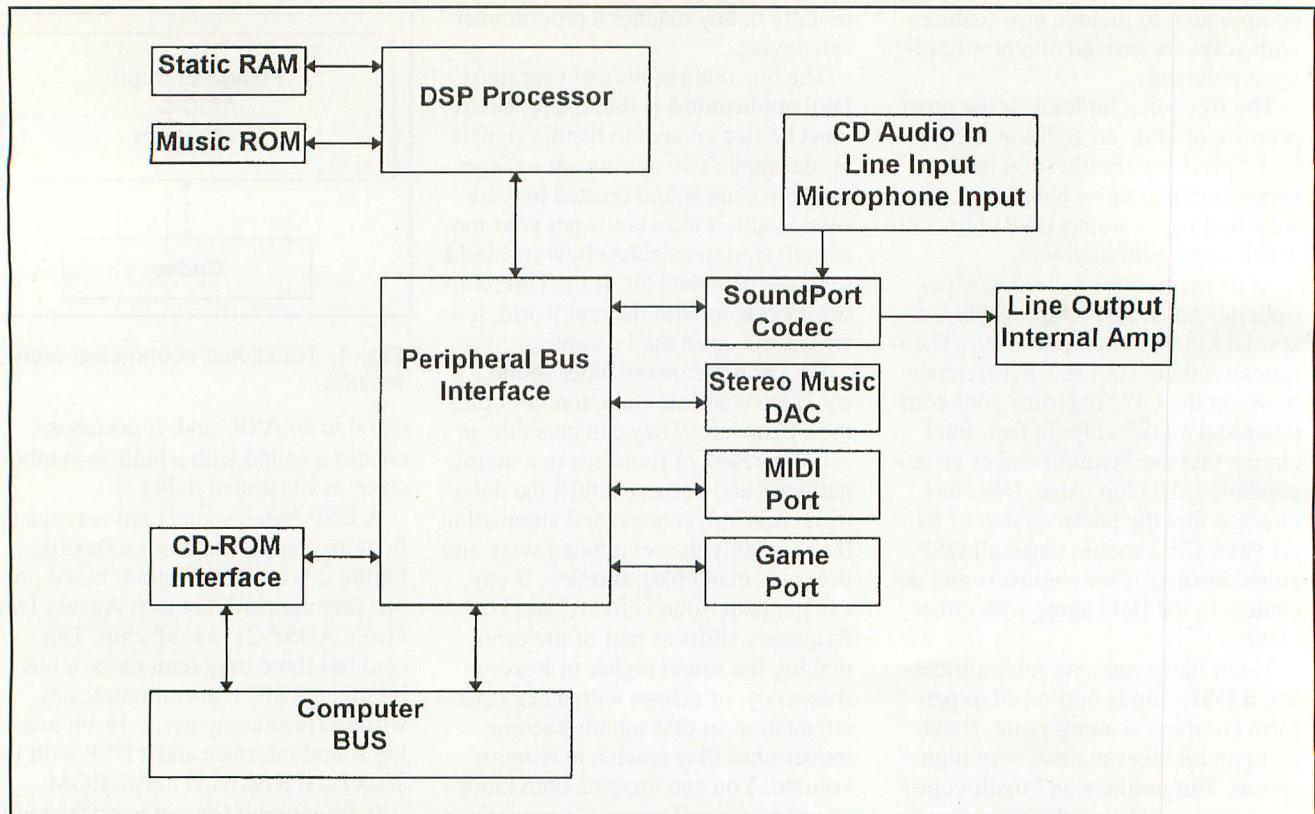


Fig. 2. Typical DSP sound-card architecture.

not the only DSP products that are now on the market. DSP-based peripherals are also appearing for other applications. The most-prominent of these are modem and fax, telephony and image-processing applications.

A DSP-based modem/fax can emulate almost any modem protocol. As long as the DSP chip is fast enough, it should be no trouble to change from a v.fc to a v.fast modem, for example, by simply changing the DSP's program. And there's no reason to be limited by the modem protocols in use today. Future protocols should be as easy to emulate as current ones are now, as long as the DSP chip is fast enough.

In addition, with proper programming, a DSP chip can encrypt data as it's sent over the telephone lines and decrypt data it receives. A fast DSP chip does away with the need for special encryption and decryption chips for relatively secure data transmission.

In addition, DSP-based modems have the capability for comparatively fast data transmission at reasonable cost, limited only by the speed and processing power of the DSP chip. As an example, transmission speeds of

128K bps aren't uncommon over dedicated lines.

Telephony, or the use of a desktop computer to control and switch telephone calls, record conversations and provide automatic answering and voice mail, depends a great deal on DSP chips and technology. Without DSP, real-time compression and decompression of voice messages would be nearly impossible to accomplish.

If you're going to use your PC as both a voice-mail machine and general-purpose computer for a home office, you need to compress both outgoing and incoming messages as much as possible to have disk space left for other applications. The same is true if you dedicate one PC or your network server to voice mail for an entire company.

As an example of how DSP technology can provide the required compression, last year Microsoft, Compaq and the DSP Group, Inc., announced a joint project to develop a technology named TRUESPEECH for Windows. Using algorithms that the DSP Group has already developed, this technology will be able to compress a 1-minute voice message to 60K bytes or

less. In comparison, some PC recording techniques use as much as a 1M of disk space for the same message. The Microsoft/Compaq/DSP Group technology will rely on a DSP chip to compress and decompress speech in real-time so that users won't notice any delays as the computer manipulates messages.

DSP promises other advances in telephony. It can remove line noise from conversations and data streams, multiplex digitized voice and modem data on the same standard phone line and encrypt and decrypt sensitive conversations.

Finally, DSP can be and is being used to manipulate images and video signal clips in the same ways that it manipulates sound signals. The major difference is that images and video tend to have a wider bandwidth and, therefore, require faster processing for real-time manipulation.

Most current DSP products for video are less concerned with special effects than they are with real-time compression and decompression of video images. Multimedia, especially business multimedia, demands that images, video clips and animation se-

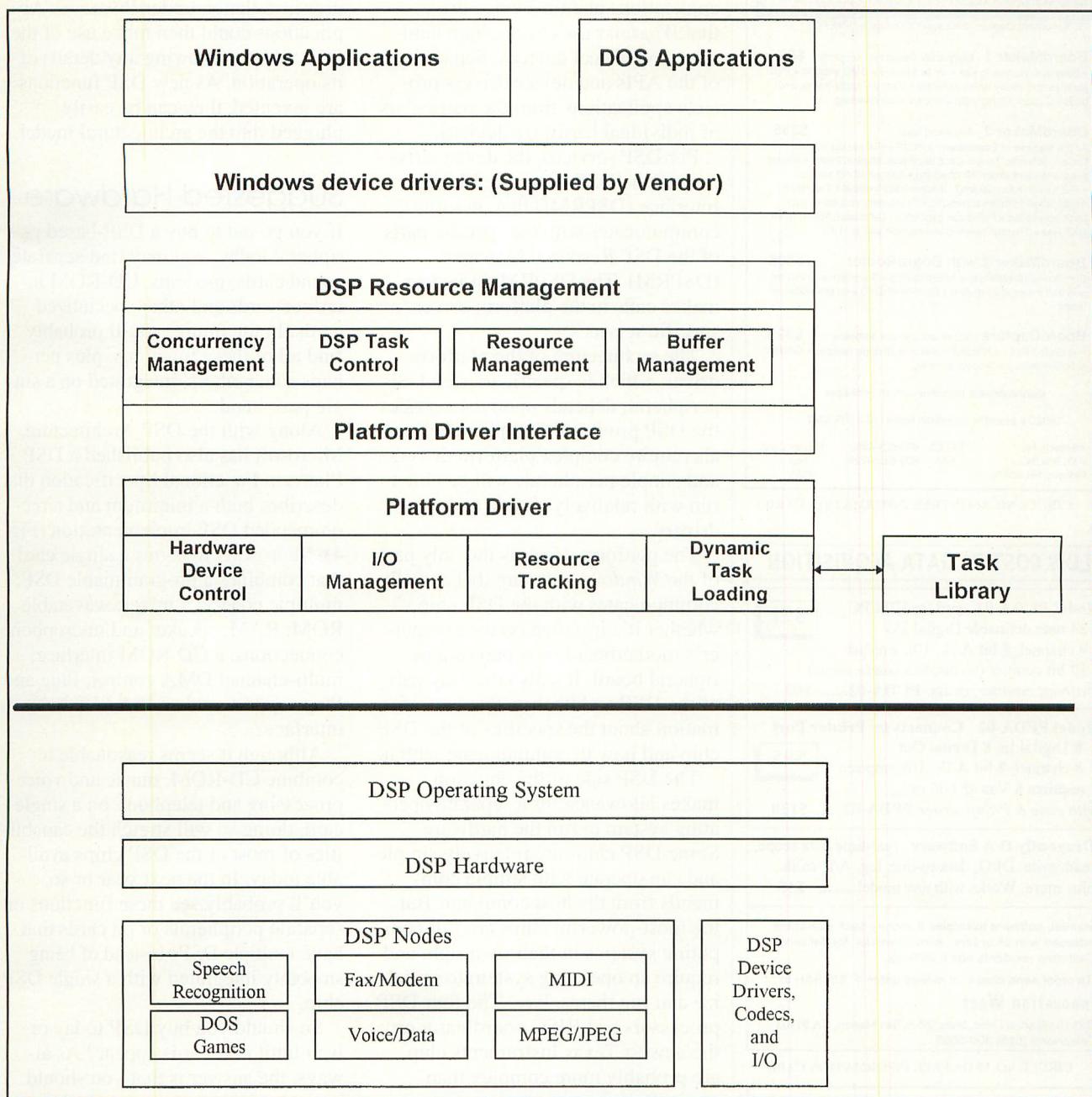


Fig. 3. Windows 95 DSP architecture.

quences be stored as compactly as possible and that they be displayed without pauses. Almost any CPU can be used to compress and decompress images, but, because of the sheer volume of data used to store, say, a 3-minute video clip in color, only a co-processor like a DSP chip can perform the necessary arithmetic while the image is being captured or displayed.

## Avoiding Chaos

Dozens of manufacturers sell or are planning hundreds of DSP-based pe-

ripherals. If the history of network cards, sound cards, scanners, CD-ROM drives and other peripherals is any indication, we should all get ready for software clashes, chaotic installation routines and frustrating calls to customer-service desks.

In an attempt to head off the expected chaos, Microsoft has developed a DSP API (application program interface) for Windows 95, along with a suggested minimum hardware standard. The hope is that with this standard, Windows and manufacturers'

drivers will provide the same hardware-independence for DSP peripherals that they do for printers, display systems, mice, CD-ROM drives and other peripherals.

Illustrated in Fig. 3 is the general outline of Microsoft's DSP interface for Windows 95. At the top of the outline, applications need only know about the Windows API and its subsidiaries. Windows 95 is scheduled to include APIs for telephony (TAPI) or Mixers, Communications and other APIs. APIs provide an interface between

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applications and the device drivers that *Windows* uses to run both hardware and virtual devices. Separation of the APIs and device drivers protects applications from the particulars of individual hardware devices.

For DSP services, the device drivers call the DSP Resource Manager Interface (DSPRMI) that, in turn, communicates with the specific parts of the DSP Resource Manager (DSPRM). The DSPRM, in its turn, makes calls to the platform driver for specific services.

The architecture of the platform driver, which is specific to each DSP peripheral, depends upon the services the DSP provides. Complex peripherals require complex platform drivers, and simple peripherals will be able to run with relatively simple and small drivers.

The platform driver is the only part of the *Windows* software that actually communicates with the DSP chip, whether it's installed on the computer's motherboard or is part of a peripheral board. It's also the only part of the DSP architecture that has information about the specifics of the DSP chip and how to communicate with it.

The DSP side of the equation makes allowance for a separate operating system to run the hardware. Some DSP chips are relatively simple and can operate with simple commands from the host computer. But the most-powerful chips are full computing systems in their own right and require an operating system to initialize and run themselves. The four DSP processors and RISC coordinator on the newest Texas Instruments chip, are probably more complex than many desktop computers and require at least a minimal operating system to keep everything working together.

Below the DSP hardware, Microsoft envisions a collection of DSP nodes plus on-board device drivers and I/O electronics. Each node can be a task, an I/O thread, a device like a voice synthesizer or a combination of elements. The ones shown in Fig. 3 are simply examples of the nodes that might be present on a multi-function DSP peripheral.

DSP architecture is complex, but it's also extremely flexible. A DSP vendor would supply the necessary *Windows* device drivers, the platform driver and the DSP task library for

user installation under *Windows*. Applications could then make use of the DSP without knowing any details of its operation. As new DSP functions are invented, they can be easily plugged into the architectural model.

## Suggested Hardware

If you go out to buy a DSP-based peripheral today, you may find separate sound cards, modems, CD-ROM interface cards and other specialized cards. In the future, you'll probably find all of these functions, plus perhaps some others, integrated on a single peripheral.

Along with the DSP Architecture, Microsoft has also published a DSP Platform Functional Specification that describes both a minimum and a recommended DSP implementation (Fig. 4). Microsoft envisions a single card that combines a programmable DSP; multiple codecs; a mixer; wavetable ROM; RAM; speaker and microphone connections; a CD-ROM interface; multi-channel DMA control; Plug and Play support; and an ISA (AT-bus) interface.

Although it seems reasonable to combine CD-ROM, music and voice processing and telephony on a single card, doing so will stretch the capabilities of most of the DSP chips available today. In the next year or so, you'll probably see these functions on separate peripherals or on cards that have multiple DSPs instead of being smoothly integrated with a single DSP chip.

So should you buy DSP today or wait until new cards appear? As always, the answer is that you should buy the equipment you need when you need it. If you do buy now, though, keep in mind that whatever equipment you invest in will probably be outdated in a couple of years.

If I needed a sound card (or sound card and CD-ROM interface combined) today, I'd select one that uses a programmable DSP. I wouldn't be so particular about a new modem, however, especially if I planned to use the modem for on-line services and bulletin boards. The advantages of programmable DSP modems justify the added cost right now, in my opinion, only if you want to create your own proprietary transmission protocols or encryption and if you or your compa-

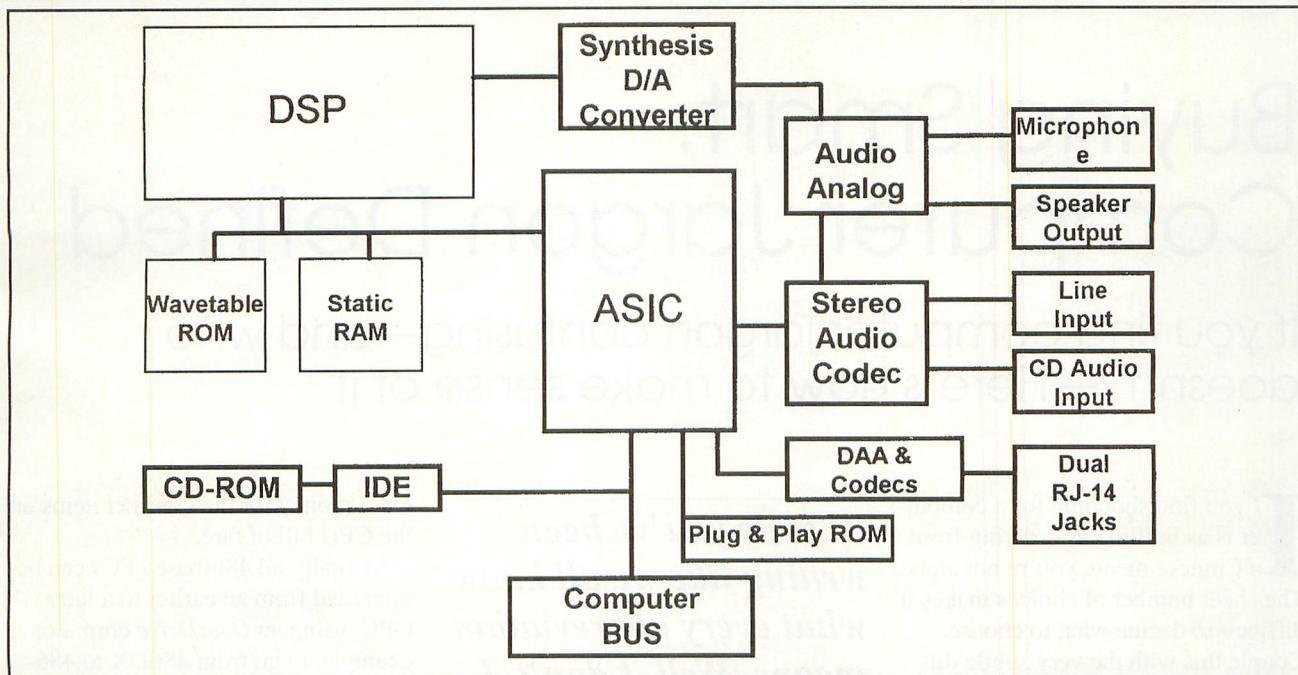


Fig. 4. Microsoft's DSP Platform Functional Specification (POTS version for telephony with analog telephone lines).

ny has the expertise to do so.

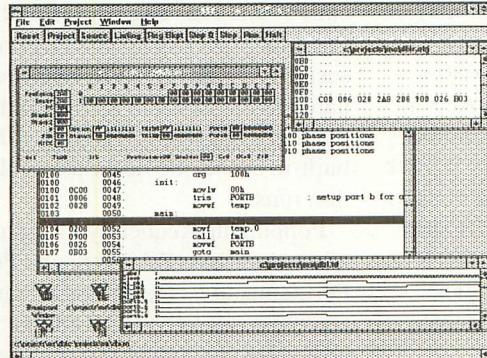
The other promises of DSP are mostly in the future, but they're coming. As the *Windows* DSP architecture

firms up and the desire for business multimedia and telephony increases, look for manufacturers to move DSP products from peripheral cards to

computer motherboards. Future computers will depend on DSP as much as they do on the standard serial and parallel ports today. ■

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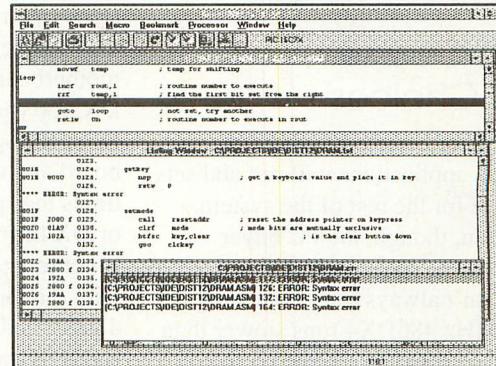


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# Buying Smart: Computer Jargon Defined

If you find computer jargon confusing—and who doesn't?—Here's how to make sense of it

If you find shopping for a computer is as baffling as ordering from a Chinese menu, you're not alone. The sheer number of choices makes it difficult to decide what to choose. Couple this with the very subtle differences between one selection and another, like the slight difference between Kung Pao Chicken and General Tsao's Chicken or SCSI-1 and SCSI-2, and the possibilities really get crazy.

Even worse is the dizzying array of jargon used in printed and TV ads. How many computer shoppers know what ARAG or RISC means? Not all that many, I think. In this article, I define most of the techie terms you run across when talking computers.

## Main Course: CPU Choices

The CPU in a computer determines how fast applications will run and sets the stage for the rest of the system. Too often, though, the PC buyer equates CPU speed with power, which isn't always true. For example, a 100-MHz 486DX4 runs slower than a 60-MHz Pentium. While there are dozens of CPU types and speeds, most of the today's PCs are powered by Intel's 486 and Pentium engines.

- **Intel Inside.** The 486 processor, the workhorse of the desktop PC, is a family of devices that includes the 486SX, 486DX, 486SX2, 486DX2 and 486DX4. SX(2) and DX(2) chips are identical in every way, except that DX processors have a built-in math coprocessor and SX chips don't. All 486 processors have a 32-bit-wide bus interface.

*"Lately you've been writing like we all know what every abbreviation means. Well, I don't. I know what SCSI stands for, but MPC2 and RISC have me going in circles."*

—David R., Atlanta, GA

The advertised speed of a 486 processor is the speed at which the chip's *internal* circuitry runs—which may or may not be the same speed as the motherboard. For example, a 486-DX2/66 (or 486SX2/66) chip runs at twice the speed of a 33-MHz motherboard and a 486DX4/100 runs at three times the speed. A DX2 clock doubler or DX4 tripler circuit inside the chip synchronizes the CPU's internal clock with the motherboard's clock. The 486SX and 486DX run at the same speed as the motherboard.

The next step up in power is Intel's Pentium series, which includes the 60-, 66-, 90- and 100-MHz processors. Unlike 486 processors, all of which have a 32-bit-wide interface, Pentium chips have a 64-bit interface that lets the motherboard run at the same speed as the CPU's internal electronics—for a noticeable gain in speed and power. However, these are the "porterhouses" of CPUs, with the 90- and 100-MHz versions cut from the prime. So be prepared to pay the

extra money for the gourmet items on the CPU bill of fare.

Virtually all 486-based PCs can be upgraded from an earlier to a later CPU, using an *OverDrive* chip. For example, to go from 486DX to 486-DX2, all you need is a 486DX2 OverDrive chip. Coming soon are OverDrive chips that turn 486DX2 systems into Pentium-compatibles and Pentium OverDrives that increase the power of a 60- or 66-MHz Pentium PC.

- **Pentium Alternatives.** NextGen's Nx586 CPU is a low-cost Pentium clone that's making major inroads into the PC marketplace. It's a RISC (see Glossary) processor that's 100% compatible with all Intel-based applications and runs slightly faster than a Pentium processor of equal speed. Its secret is a 32K on-board cache, compared to the Pentium's 16K cache and the 486's 8K cache. The larger the built-in cache, the faster the application runs.

Popping up frequently in computer ads is the PowerPC. While the PowerPC claims to be faster than a Pentium and promises to be PC- and Macintosh software-compatible, until applications are written specifically for the PowerPC, they'll run in very-slow *emulation* mode. Typically, they run about as fast as they would on a 386 system of the same clock speed.

Far outstripping the Pentium in both speed and power (not to mention price) are the Alpha and R4000/R4400 processors. Touted as the world's fastest desktop PC processors, the Alpha chips from DEC (Digital Equipment Corp.) run at a blazing 275 MHz. The more-conservative

R4000/R4400 run at a cooler 150 MHz. Both are RISC processors. As with the PowerPC, you need programs that are specially written for the Alpha or R4000/R4400 before the afterburner kicks in—which looks to be a few years away. However, there's a version of *Windows NT* (*Windows NT Daytona*) that lets you run your present library of DOS and *Windows* software at about twice the speed of a 60-MHz Pentium.

## Side Dishes Served in Expansion Slots

The distinctions between ISA, EISA and local bus—all of which are types of expansion slots that are used to add peripherals like video controllers and internal modems to a system—probably cause the most confusion. The difference between ISA or EISA and local bus is the speed at which data is moved between the CPU and the peripheral. Most ISA and EISA slots run at 8 MHz, whereas local-bus slots run at the same speed as the motherboard. For example, the local bus of a 486SX/25 runs at 25 MHz and the local bus of a 486DX2/66 runs at 33 MHz. As always, faster is better.

• **ISA or EISA.** The original PC slot was an eight-bit ISA connector designed for the 8088-based IBM PC. In 1984, the ISA slot was upgraded to 16 bits for use in the IBM PC/AT. Today's ISA slot is both eight- and 16-bit-compatible and is supported by the majority of card peripherals on the market today.

The EISA slot is an enhanced version of ISA. It has a 32-bit interface with bus mastering (a technique that permits two peripherals to communicate with each other without involving the CPU) that accepts both ISA and EISA cards. However, you need to use EISA cards to garner any gain from the wider bus—and then only with systems that do a lot of I/O (input/output), like a network file server.

• **VL-Bus and PCI.** Both the VL-Bus (sometimes called VLB or VESA LB) and PCI are local-bus slots. The VL-Bus is an older technology that's being phased out in favor of PCI. A few systems claim to support both VL-

Bus and PCI. However, problems arise when you mix the two technologies. Consequently, such a combo should be avoided. Despite rumors to the contrary, both are 32-bit buses, not 64-bit buses, as some ads lead you to believe.

## Soup or Salad: IDE and SCSI Explained

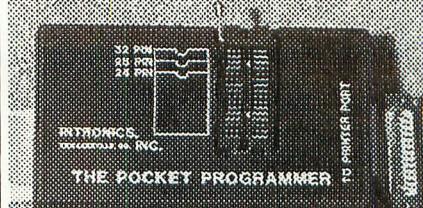
Not all peripherals connect to a system via an expansion slot. Good examples are the hard disk and CD-ROM. Generally, these devices interface through an IDE or SCSI port.

• **SCSI.** SCSI interfaces come in three different serving portions: SCSI-1, fast SCSI-2 and fast/wide SCSI-2. SCSI-1 has an eight-bit bus that runs at 5 MHz to provide a top data-transfer rate (DTR) of 5M per second. The increasingly popular SCSI-2 is similar to SCSI-1, except that it has a faster

*“When I purchased my computer, I was introduced to EISA, ISA and local bus. Although I didn’t fully understand what they meant, salespersons led me to believe that the EISA configuration would be best for my uses. A year later, and many dollars lighter, I find no noticeable speed improvement. I’d like to buy something faster, but I don’t want to get burned again. Please explain, the differences between EISA, ISA and PCI.”*

—Jerry G., San Francisco

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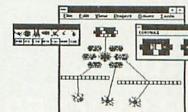
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## Corrections & Amplifications

The following refer to the March/April 1995 issue of *MicroComputer Journal*:

- We failed to credit the model on the cover photo. She's Susan Benford, niece to Tom Benford, who wrote the "Morphing Demystified" article that was the subject of the cover photo.
- The captions for Fig. 5 and Fig. 7 were transposed. The illustrations themselves are in correct order. Simply shuffle the captions.
- The photo to which reference was made in "Bits & Pieces" on page 94 was accidentally omitted. Here it is.



CIRCLE NO. 59 ON FREE INFORMATION CARD

**"I ran across an ad in the paper selling a Multimedia upgrade kit complete with CD-ROM and sound board at what appears to be blow-out prices. What is Multimedia, and why do I want it?"**

—Lynn B., via Internet

clock rate and/or wider bus. With fast SCSI-2, the clock is 10 MHz with an eight-bit bus, for a DTR of 10M per second. With fast/wide SCSI-2, the clock is still 10 MHz, but the bus is 16 bits wide and provides a 20M-per-second DTR.

A fourth version of SCSI is SCSI-3, which isn't the same as fast/wide SCSI-2, as some ads claim. Additionally, it's not popularly supported by the desktop PC.

• **IDE.** IDE devices are more popular than SCSI ones because they're less expensive and easier to install. However, IDE isn't considered a top performer. For many years, PC users opted to use the more-expensive SCSI interface over the IDE for three reasons: greater throughput, greater drive capacity and the ability to daisy-chain peripherals. But the recent development of the *enhanced IDE* interface has changed this picture.

Enhanced IDE has a data throughput of 16.7M per second, which is nearly that of fast/wide SCSI-2. It supports hard disks as large as 8G in capacity. And one controller can handle up to four devices.

## Displays: Presentation Is Everything

A computer without a super-VGA color monitor is like an entree without seasonings. Sure, a 14" VGA screen is functional, but only to the same extent a Big Mac satisfies your hunger. To really enjoy the power a 486 or

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**Table 1. Suggested Minimum Hardware Requirements For Multimedia Applications\***

	<b>MPC</b>	<b>MPC2</b>
<b>CPU</b>	386SX/20	486SX/25
<b>Memory</b>	2M	4M
<b>Hard Drive</b>	30M	160M
<b>Sample Playback Quality</b>	22 kHz, Eight-Bit	44 kHz, 16-Bit
<b>Sample Recording Quality</b>	11 kHz, Eight-Bit	44 kHz, 16-Bit
<b>Synthesizer</b>	Eight-Voice, MIDI	Eight-voice, MIDI
<b>MIDI In/Out</b>	Yes	Yes
<b>CD-ROM Sustained DTR</b>	150K Bits/Second	300K Bits/Second
<b>Read Multisession CD</b>	No	Yes
<b>Video</b>	640 x 480 x 256 Colors	640 x 480 x 65K Colors
<b>Digital Video Playback</b>	N/A	320 x 240, 15 Frames/Second

\*Suggestions aren't carved in stone; it's likely that MPC2 software can run successfully on a 386 system—albeit a lot slower.

Pentium processor has to offer, you must go beyond everyday fare. The acronyms on this menu, though, are plentiful. Fortunately, they're easily defined.

The most-popular term is *flat square*, which describes the almost window-pane shape of the screen commonly used with 15" and larger monitors.

To improve the clarity of the image, most monitors have some kind of screen treatment to reduce glare and reflections from overhead lighting. The most-common is silica, followed by antireflection, antiglare (ARAG); antireflection, antistatic (ARAS); and antiglare, antireflective, antistatic (AGRAS). While it hasn't been proven that monitor emissions constitute a health risk, most monitors comply with the Swedish Government's Department of Labor (SWEDAC) MPR II rating that limits potentially harmful monitor emissions to a safe level.

The video display is driven by a video controller, which most often is an adapter card that plugs into a motherboard expansion slot. Most video cards sold today contain a *Windows accelerator*, which is a video controller chip that speeds up *Windows*-based applications. Some of these cards use VRAM for even faster response time, and all use a RAMDAC (sometimes called video DAC) to convert the digital signals into screen colors. The number of bits supported by the RAMDAC determines the number of screen colors. An

eight-bit RAMDAC can do 256 simultaneous colors, while a 24-bit RAMDAC does 16.7-million colors.

## Dessert Anyone?

Add-ins/ons beyond the basics required for common desktop/laptop computing tasks can propel you into cutting-edge regions of computing. The ads are filled with meat and hype on this score. You'll see everything ranging from "bare bones" to "fully equipped PCs" listed, the latter touted to have things like communications and multimedia facilities built into them. Cutting through the meat and the hype can be as daunting and as dangerous on your wallet as cutting a trail through an alligator-infested swamp.

• **Multimedia.** The fastest-growing sector of the PC market is *multimedia*, a term used to describe applications that make special use of audio and video, either separately or together. The types of multimedia applications include games, computer music and animation video.

At the heart of any good multimedia system is a CD-ROM drive. The most-popular drives are double-speed units that have a data-transfer rate of 300 kilobytes per second (K/s). More-expensive drives run at 450K/s triple speed and 600K/s quadruple speed. CD-ROM drives that can read Kodak Photo disks have a *Photo CD* designation, and those that can read more than one Photo CD recording session display the *multisession* logo. MPC

and MPC2 suggest the minimum system requirements for multimedia applications (Table 1).

Though you can get sound from your PC's built-in speaker, it's far from even decent quality. A better move is to buy a *sound card*. Sound cards commonly have a MIDI port for composing and playing music via an external keyboard (such as those made by Casio) or other MIDI device. Sounds are generated either by a *synthesizer* (good), ASP chip (better) or a *wavetable* (best).

• **Communications.** Also on the dessert cart, and as addictive as chocolate, is on-line networking, like that provided by America Online, CompuServe and Internet. To access these services, you should have a high-speed modem that has advanced communications well beyond the modems of yesteryear.

Even though many services still run at 2,400 bits per second (bps), modern modems run at 14.4K bps, and many run at 28.8K bps. So why buy more speed than you need? The answer is: for the same reason you buy a Pentium PC—today's exotic cuisine will be tomorrow's fast food.

When talking modem jargon, understand that the *bis* extension, as in V.32bis, indicates an upgrade from a previously-defined protocol. Generally, the *bis* version either runs faster and/or includes error correction. But with so many different *bis* versions on the market, none of which are related, make sure yours is the correct one for your communications software.

## Glossary of Technical Terms

### Processor

**Alpha.** With clock speeds up to 275 MHz, the Alpha processor from DEC is touted as the world's fastest desktop CPU.

**CISC.** Complex Instruction Set Computing is the instruction set used by 486, Pentium and Motorola 68040 processors. (See RISC below.)

**DX2.** Any Intel or 486DX2 clone CPU that runs internally at twice the speed of the motherboard and local-bus slot.

**DX4.** Any Intel CPU that runs internally at three times the speed of the motherboard and local-bus slot.

**Emulation Mode.** A software interface used by Alpha and other CPUs that interprets Windows and DOS instructions and converts them into the processor's native language.

**FPU.** The floating Point Unit is a math coprocessor that's usually built into the CPU to accelerate mathematical operations, like those used by spreadsheets and CAD programs.

**Nx586.** A low-cost Pentium alternative from NextGen.

**OverDrive.** Any CPU upgrade chip that boosts the speed or power of 486, DX2 or Pentium systems. While OverDrive is a trademark of Intel, other vendors make comparable upgrades that salespeople often mistakenly call OverDrives.

**Pentium.** Intel's high-speed successor to the 486.

**PowerPC.** A processor developed by the collective minds of Apple, IBM and Motorola. Its claim to fame is that it runs both PC and Mac software, but so slowly that it doesn't do justice to either.

However, PowerPC-specific applications are in the works, which may make it a viable processor for cross-platform users.

**R4000/R4400.** Two RISC processors from MIPS, Inc. that run at speeds up to 150 MHz.

**RISC.** Reduced Instruction Set Computing, or RISC, instructions are very simple and short, which permits the processor to

run faster than CISC processors.

**SMP.** Symmetrical MultiProcessor is a technology that uses more than one processor in a single system. Special software is required.

**SX, SX2.** An Intel CPU that's identical in every way to its DX or DX2 counterpart, except that it doesn't have a built-in math coprocessor.

### Motherboard

**Bus Mastering.** A method by which an expansion card transfers data to another expansion card or other peripheral via the expansion bus without involving the CPU.

**EISA.** The Extended Industry Standard Architecture is an aging 32-bit motherboard slot that's backward-compatible with ISA.

**Expansion Slot.** Any slot on the motherboard that accepts adapter cards.

**Flash BIOS.** A reprogrammable memory chip (typically an EEPROM) used to store the computer's basic input/output instructions, a small quantity of code used for controlling fundamental computer operations. Unlike ROM BIOS, flash BIOS can be upgraded via software from the vendor or files found on an on-line service like CompuServe.

**ISA.** The Industry Standard Architecture is the most-popular motherboard expansion slot that typically runs at 8 MHz, which is a lot slower than a local-bus slot.

**Local Bus.** Any motherboard slot that runs at the interface speed of the CPU. For a 486DX2/66 system, local-bus speed is 33 MHz.

**Memory Cache.** A small chunk of fast RAM used to store frequently-used instructions or data. There are two types: primary cache built into the CPU and secondary cache installed on the motherboard.

**PCI.** The most-popular local-bus slot.

**SIMM.** This single In-line Memory Module is a staple of main memory that comes in 30- and 72-pin versions.

**VL-Bus.** The VESA local bus is an aging local bus that runs at speeds up to 66 MHz. It's also advertised as VLB and VESA LB.

**Write-Back Cache.** A cache scheme that delays writing data to the hard disk during periods of heavy use to increase data throughput. While write-back is faster than write-through, it's less safe because data can be lost if power fails.

**ZIF Socket.** The Zero Insertion Force socket is a lever-operated IC socket that's commonly used for performing quick and hassle-free CPU upgrades.

### Drives

**CD-I.** Compact Disk Interactive is a standard developed by Philips that lets you connect your CD-ROM to your TV receiver. It's becoming increasingly popular with cable-TV channels.

**CD-ROM.** The Compact Disk, Read Only Memory is an optical disk that can store up to 680M of data.

**Double Speed.** This denotes a CD-ROM drive that has a data-transfer speed of about 300 kilobytes per second (K/s). Triple-speed CD-ROMs run at 450K/s, and 4x drives run at 600K/s.

**Enhanced IDE.** A recent upgrade of the popular IDE standard that runs at 16.7M/s and supports drives with capacities as large as 8G.

**IDE.** Integrated Drive Electronics is the most-popular type of hard-disk drive.

**SCSI.** The Small Computer Systems Interface, pronounced *scuzzy*, is the fastest interface for hard disks. It's also the most-expensive.

### Displays

**AGRAS.** An antiglare, antireflection, antistatic screen treatment that reduces glare and reflections from ambient and overhead lighting.

**ARAG.** An antireflection, antiglare screen treatment that reduces glare and reflections from ambient and overhead lighting.

**ARAS.** An antireflection, antistatic screen

## PCs On the Go

Since its introduction some 10 years ago, the portable computer has undergone an incredible metamorphosis—and so has its jargon. Unlike desktop computers, portables use a liquid-crystal display (LCD) instead of a CRT (cathode-ray tube) screen. Passive LCD displays are less bright than

active LCD displays, and dual-scan LCD displays fall halfway between the two.

Most mobile PCs come with at least one PCMCIA slot. Essentially, the PCMCIA slot is the portable's equivalent of the desktop's ISA or local-bus slot. It's used for all kinds of plug-in devices like modems, network

adapters, hard and solid-state disks and memory.

Because space inside a portable computer is so limited, sophisticated peripherals and disk drives are often interfaced via an *enhanced parallel port*. A *docking station* converts a portable PC into a desktop system by providing connections for a CRT

treatment that reduces glare and reflections from ambient and overhead lighting. **CRT.** The cathode-ray tube is the picture tube in your monitor and home TV receiver.

**Energy Star.** A set of guidelines developed by the Environmental Protection Agency (EPA) to reduce power consumption in computer devices.

**Flat Square.** A nearly flat CRT display that has greater viewing area and less distortion than a spherical screen and is typically found in 15" and larger monitors.

**MPR II.** A rating established by Swedish government (SWEDAC) that limits potentially harmful monitor emissions to a safe level.

**NI.** Noninterlace scanning is a video mode that draws images on the screen one line after the other, as opposed to interlaced, which draws the even-numbered lines on one pass and the odd-numbered lines on the next pass. It exhibits less flicker than interlaced scanning.

**NTSC.** The National Television Standard Committee is the video standard for U.S. television broadcasts that provides for 525 scan lines per screen and 30 interlaced frames per second. It's often used in multimedia.

**RAMDAC.** The Random Access Memory Digital-to-Analog Converter is the chip that converts digital signals into screen colors. An eight-bit RAMDAC generates 256 simultaneous screen colors, and a 24-bit RAMDAC can do 16.7-million colors.

**VESA.** The Video Electronics Standards Association is a trade organization of graphics hardware manufacturers that develop guidelines for video products and expansion slots.

**VRAM.** Video Random Access Memory is a dual-ported memory that speeds along screen displays, particularly Windows.

**Windows Accelerator.** Any video card that uses a video chip with built-in instructions to increase the speed of Windows.

*downs* applications. Very few video cards sold today don't have a Windows accelerator.

### Multimedia

**ASP.** The Advanced Sound Processor is a sound technology introduced by Creative Labs (makers of the SoundBlaster sound card) that produces audio quality between that of synthesized voices and wavetables.

**MIDI.** The Musical Instrument Digital Interface is a standard created by musical-instrument manufacturers for the digitizing of music.

**MPC.** Multimedia PC is a specification that suggests the minimum hardware requirements for multimedia. (See Table 1).

**MPEG.** The Motion Picture Experts Group consists of a number of popular video compression schemes (MPEG 1, MPEG 2, etc.) that are used to reduce the size of animated video files.

**Multimedia.** A term used to describe any application that involves CD-ROM, sound and/or motion video.

**Multisession.** A term used to identify CD-ROM drives that can read more than one Kodak photo session from a Photo CD.

**Photo CD.** A technique developed by Kodak that digitizes photographs and stores the files on a CD-ROM.

**Sound Board (or Card).** An expansion card that improves the quality of PC sound.

**Synthesizer.** The method used to generate sounds by mixing different frequencies called voices.

**Wavetable.** A method used by some sound cards to store actual digital sounds of real instruments, resulting in better sounds than those possible by the synthesized voice method.

### Communications

**Internet.** A worldwide on-line network that can be accessed via CompuServe and America Online for e-mail messages or

through an Internet provider, such as Delphi (about \$30 per month), for full services.

**V.32.** The communications standard for 9,600-bps modems.

**V.32bis.** The communications standard for 14.4K-bps modems.

**V.34.** The communications standard for 28.8K-bps modems.

### Mobile PCs

**Docking Station.** A desktop platform that has connectors and a power supply for a portable computer so that it can connect with a CRT monitor, printer and other peripherals. Essentially, it turns a portable computer into a desktop computer.

**Enhanced Parallel Port.** A parallel port capable of sending and receiving data at speeds approaching 1M/s (compared to 80K/s for a standard parallel port).

**LCD.** The liquid-crystal display is the display medium used for portable computers.

**LID.** Lithium Ion Storage is the newest battery technology used in portable computers. Has a longer life and greater power-to-weight ratio than NiCD or NiMH batteries.

**NiCd.** Nickel-Cadmium is the least-expensive type of rechargeable batteries. They aren't as common as they used to be and are less-desirable than NiMH and LID.

**NiMH.** Nickel-Metal-Hydride is the most-popular rechargeable battery used in portable computers. It has a longer battery life than an NiCd and a faster recharge time (about 1 hour compared to 3 hours and more).

**PCMCIA.** The Personal Computer Memory Card International Association is the portable computer's equivalent of an expansion slot. It uses peripherals the size of a credit card.

**TFT.** The Thin-Film Transistor is an active semiconductor device built into the screen of an LCD panel to improve brightness and contrast.

monitor and multiple serial and parallel ports.

Until recently, portable PCs were powered by NiCd batteries. Today you'll find most notebooks and sub-notebooks are powered by NiMH batteries, which are less toxic and store more energy in a smaller space. Lithium-ion storage batteries (LIS) are best

of all because they store more energy per pound than either NiCd or NiMH, last longer and are the least toxic.

### Check, Please

When it comes to picking up the tab, expect the size of the check to increase as the number of features and speed of a PC increase. In other words, a fully-

loaded 486DX2 multimedia system is going to cost you more than a stripped-down Pentium PC. Then there's this tip: bone up on the current lingo by scanning the ads in the backs of computer magazines, like *MicroComputer Journal*, before leaving home. You'll save time and money and enjoy the experience a whole lot more.

## Microcomputer Q&A

By TJ Byers

**In this column, I answer questions about all aspects of computer disciplines, both hardware and software, plus related electronic queries. You can reach me on America Online at TJBYERS, on CompuServe or Internet at TJBYERS@aol.com or by mail in care of *MicroComputer Journal*, 76 North Broadway, Hicksville, NY 11801.**

### Where Did MOVE Put That File?

**Q.** Using the *MOVE* command, I accidentally moved a document file to a nonexistent directory. I've searched everywhere, all drives and subdirectories (what a job!), and it's nowhere to be found. What happened to my file? Should I look for it in the twilight zone or kiss it goodbye?—Dan Maloney, via America Online

**A.** You've accidentally discovered a little-known feature of *MOVE*. If you specify a path that isn't recognized by *MOVE*, it simply renames the file. What you've done, in effect, is the same thing as using the *RENAME* command. Look for your file in its original directory under the file name of the directory you thought you were sending it to.

By the way, this occurs only when moving single files. If you try to move more than one file to a nonexistent directory, you're asked if you want DOS to create the directory for you.

### Where Did I Put That File?

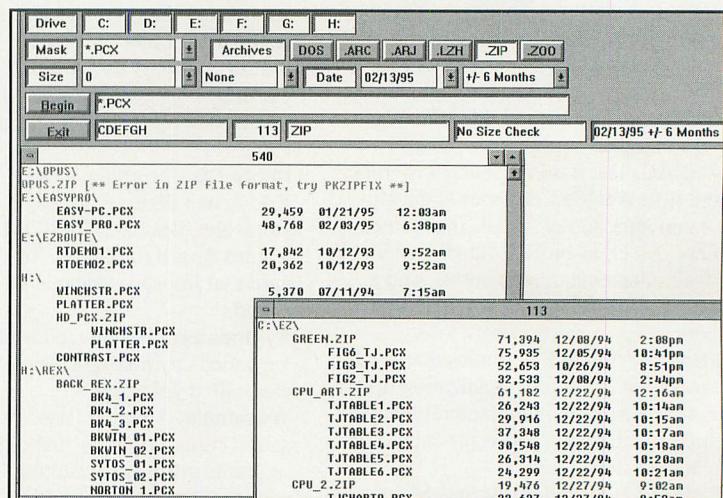
**Q.** My hard disk contains thousands of program and data files, most of which are organized in a logical way so that they're easy to find. However, the other day, I created a file using a notepad utility while taking a telephone message and saved it in the first directory that popped up as I dashed out the door to a meeting. Now I can't remember where I put it or the full name of the file. I really dread having to spend hours scrolling through my hard disk in search of the file. Is there a faster, easier method?—Mark Caroll, San Francisco

**A.** Well, there are several programs that let you search for "lost" files—including DOS's *DIR* and *Windows*' File Manager. And it doesn't have to take that long, if you know anything at all about the file. For example, to find a file you saved with an *.MSG* extension, you can use:

**DIR C:\\*.MSG /S**

You can also do the same thing using *Windows*' File Manager found in the Main icon. If you don't remember the whole name, wildcards work as place holders for single (?) and multiple (\*) characters. But the more you know about the filename, the more focused your search will be. You can even find ready-only and hidden files. For example, if you're looking for two hidden files named *SAVE01.BIN* and *SAVE-02.BIN*, use the following:

**DIR C:SAV??.BIN /AH /S**



**Fig. 1.** Have you misplaced a file and can't find it? As long as you remember something about it—like any part of its name, date, or extension—*Where Are You* can find it. You can even search for archived and compressed files. In this example, the first search was for all *.PCX* files, which I narrowed down to zipped *.PCX* files created within the last six months for the second search. You can find *Where Are You* under the filename *WRU311.ZIP* on CompuServe and America Online, as well as select BBSes.

The secret is to start at the root directory and remember to add the */S* switch to do a complete drive search. However, the problem with most file-finder utilities, including *DIR* and File Manager, is that even though you can chase all sorts of files through 32 levels of subdirectories, you can search only one logical drive at a time. Also, you can't search archived or compressed files using these utilities. Fortunately, there are inexpensive programs that let you do this, including *PC Tools* and *Norton Desktop*. For the shareware user, I recommend *Where Are You* from AT-Ware (Fig. 1).

## DPMI and Doom

**Q.** The other day, I purchased a copy of *Doom* and installed it on my Tandy *Sensation*. Installation went just fine. But when I tried to play the game, all I got was a glaring "Insufficient DPMI Memory" error message. Undaunted, I did a Defrag, ran MemMaker and installed *Doom* once again. But, as with the first installation, I got the error message. This is all very confusing because I have 4M of RAM, plenty enough according to the manual, and did everything by the book. So exactly what is DPMI memory, and how do I increase it?—John B. via Internet

**A.** Developed by a consortium of industry leaders in the late 1980s, the DPMI (DOS Protected Mode Interface) specification permits a DOS-based program to access memory beyond 1M while maintaining system protection. DPMI is commonly used to communicate with a terminate-and-stay-resident (TSR) program or a DOS device driver. Frequently, the DOS application will use buffers it creates in conventional memory (640K and below) to pass data from DPMI memory to the program.

*Doom* is a DOS-based program that requires 4M of memory. Since conventional RAM doesn't have this much memory, *Doom* uses a DPMI driver to provide the rest.

The problem is that memory beyond 1M also has to be shared with extended memory (XMS) and expanded memory (EMS). When there's not enough memory to go around, you get memory error messages, as you're experiencing.

To free up more DPMI memory, you need to unload XMS or EMS memory by REMing out the HIMEM.SYS and SmartDrive lines from your CONFIG.SYS and AUTOEXEC.BAT files. Unfortunately, most of us need these programs to run *Windows*, and it's a real pain to edit the start-up files each time you wish to play the game. So a better solution is to re-boot your PC when you want to play and press the F5 key when you see the "Starting MS-DOS..." message. This causes the system to bypass the CONFIG.SYS and AUTOEXEC.BAT files and gives you a DOS prompt without all the extra baggage. Now simply change to the *Doom* directory and have a blast. When you're done playing, re-boot the system to get back your XMS and EMS memory.

## VCPI Memory

**Q.** I have several programs that need both VCPI and conventional memory to run. According to everything I've heard, VCPI support is built into MS-DOS. Well, I'm running DOS 6.22, yet I keep getting error

messages that tell me my system doesn't support VCPI. What gives?—Mark Anchor, via Internet

**A.** Several popular DOS-based applications use DOS extenders to access memory beyond 1M, including DPMI and VCPI (Virtual Control Program Interface). VCPI is an extension to the expanded-memory services (EMS) and is typically implemented by an EMS emulator, such as EMM386.EXE or Quarterdeck's QEMM-386.SYS. However, getting VCPI up and running varies according to your DOS and Windows version.

To enable VCPI support in the version of EMM386.EXE provided with DOS 5.0 and Windows 3.1, you must configure EMM386.EXE to emulate EMS. This takes memory away from XMS programs like SmartDrive. If you wish VCPI without EMS support, add the NOEMS switch and specify a VCPI memory-pool size. For example, to implement 1M of VCPI memory without EMS support, add the following line to your CONFIG.SYS file:

DEVICE=EMM386.EXE 1024 NOEMS

With DOS 6.0 and later, VCPI services are provided by default—no special switches or parameters are required. However, you must have both HIMEM.SYS and an EMS memory manager installed for it to work. When active, the amount of XMS memory reserved by EMM386 (default is 256K) is no longer available, except for EMS/VCPI use.

Disabling VCPI reduces the amount of XMS memory allocated. If you wish to disable VCPI, you must use the NOVCPI switch on the EMM386.EXE command line in the CONFIG.SYS file. For more information on the EMM386.EXE device driver and the NOVCPI switch, type HELP EMM386.EXE at the DOS prompt.

## Thermally-Calibrated Hard Disk

**Q.** What is a thermally-calibrated hard disk?—Marge Rolena, Concord, NJ

**A.** Essentially, a thermally-calibrated hard disk is any hard drive that compensates for temperature changes that may occur during operation. Ambient temperature changes are generally brought about by fluctuations in the CPU's workload. Temperature inside the case rises and falls in accordance to the amount of CPU usage, which, in turn, causes the hard disk platters to expand and contract in size. This ultimately causes the heads to drift off-track.

Most disks compensate for this drift by periodically moving the head to calibration points on the platter and making alignment corrections accordingly. Typi-

ally, it takes several seconds to make an alignment correction. During high data-traffic periods, as would be the case when doing real-time animation, this results in jerkiness or video drop-out. A thermally-calibrated drive prevents this from occurring by breaking the calibration process into smaller, bite-sized procedures that take less time to do.

## Dual-Pentium Systems

**Q.** Lately I've been hearing a lot about dual-Pentium PCs that, it's claimed, can run circles around my single-Pentium system. Is this true, and if so, how much speed would I gain if I bought one?—Eugene Vicente, via CompuServe

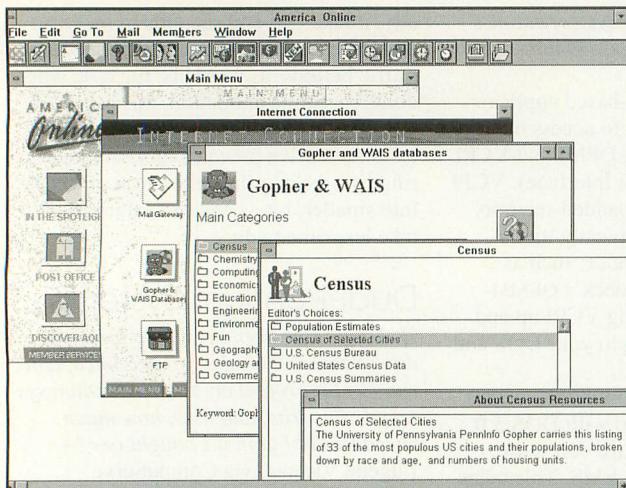
**A.** What you're talking about is Symmetrical MultiProcessor (SMP) systems, which are frequently showcased as the "ultimate" desktop PC. SMP isn't limited to Pentium processors. 486 processors can also be paralleled or paired with a Pentium. In an SMP system that's running a 32-bit operating system like *Windows NT* or OS/2, multiple operations can run virtually simultaneously in parallel—like the big boys, such as Cray supercomputers.

Basically, the two processors divide the workload between them and actually process different parts of the code simultaneously. While a dual-Pentium PC would run more than twice as fast as your system, it takes special software that knows exactly when and where to split the instructions. In other words, don't expect *Excel* to run any faster with two CPUs than it does on one. I know of only a couple SQL database programs that have actually been written to take advantage of SMP, and the only other SMP software I'm aware of is some kind of Pentium-based SMP file server that Novell has in the works. So I'd hold off on purchasing a dual-Pentium PC for a while.

## You Don't Need Two Game Ports

**Q.** My SoundBlaster Pro sound card has a connector that doubles as a MIDI and game port. This is cool. But the other day, I bought an Enhanced IDE controller card that also has a game port. Well, you can guess the rest. Now neither game port works. What can I do to fix it?—Mike G., via CompuServe

**A.** The problem is that you have two hardware devices vying for the same IRQ and address space. The cure is to remove or disable one game port so that only one is active. Generally, all you have to do is move a jumper on either the sound card or the IDE controller card to disable the selected game port. With the SoundBlaster Pro, removing the jumper block from JP4



**Fig. 2.** Many on-line services, like America Online, have access to Internet Gophers that can be used to access all sorts of information, like the census data shown here.

**Fig. 3.** If you know your way around *WinWord* and are comfortable working without a net (as in no toolbars and pull-down menus), you can increase your working area by using the Full Screen mode found under the View menu. To return to regular viewing, simply click on the Full icon located in the lower right corner or hit Esc.

disables the game port on the card. Some cards let you use your sound card's software to turn on and off the game port.

## Coprocessor Speeds Excel

**Q.** I do a lot of work at home using a 25-MHz 386 PC with a Windows video accelerator card. Although I use a 486 PC at work, I'm surprisingly happy with my old 386's performance—except when I'm recalculating tables in Excel. Would adding a math coprocessor speed up the operation?—Roger Tyson, via CompuServe

**A.** Yes. Excel will make use of a math coprocessor if one is available. However, don't expect your 386 PC to perform like the 486 you have at work, even with a math coprocessor. Other factors, like the architecture of the pipeline, make the 486 CPU superior to the 386.

## Census, Internet and Gophers

**Q.** I read somewhere that the census data has been summarized by various geographic levels for race, age, income and a whole bunch more. I also seem to recall that this data is available on CD-ROM. Do you know how I can lay my hands on this information and its cost?—Frank Knorr, D.C.

**A.** Well, there are plenty of vendors out there who are willing to trade your dollars for census data. And the more specialized the data, the greater the cost. Expect to

pay up to \$1,000 and more a pop for such information. On the other hand, if you don't mind dropping a dime and dialing up the Internet, you can have all this data free for the asking. If you're not so lucky as to be an Internet subscriber, you can still access these figures through most of the on-line services, like America Online and CompuServe.

Without going into a lot of detail, it's done through "Gophers." Gopher is a way of browsing lots of information on the Internet via organizations or sometimes individuals from all over the world who like to organize and make available all kinds of information. For example, to find census information using AOL, simply call up the Internet connection and click on the Gopher/Census options (Fig. 2).

## Full-Screen Viewing in WinWord

**Q.** I was fooling around in Word for Windows the other day, and clicked on an icon that made the document the size of the screen. Now I can't get back to where I started because there are no icons or toolbars on the screen. So how do I get back to square one?—Confused, via Internet

**A.** You didn't say which version of *Word* you're using, so I'll have to guess that it's Version 2.0, which has the screen you describe. In *Word* 6.0 there's an icon located in the lower-right corner of the screen that will return you to normal when you click on it. Or you can simply press the Esc key.

Regardless of which version of *Word*

A: Well, the more for the Internet, you place via telephone. Without going to all the trouble, you can still access these figures through most of the on-line services, like AOL, simply call up the Internet connection.

out there willing to trade your dollars for census data. Higher the cost. Expect to pay up to \$1,000 a pop and, if you don't mind dropping a dime and dialing up for the asking (remember, you paid for it in the first place). As to be an Internet subscriber, you can still access Internet via organizations or sometimes individuals organize and make available all kinds of Internet this information using AOL, simply call up the Internet Census options (see Fig. xxx).

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**A.** You didn't say which version of *Word* you're using, so I'll have to guess it's version 2.0, which has the screen you describe. In *Word* 6.0 there's an icon located in the lower-right corner that will return you to normal when clicked on. Or you can simply press the Esc key. Regardless of which *Word* version you're using, pressing Alt-V will always bring up the View menu that'll let you get back home by clicking on the mouse Full Screen option (see Fig. xxxx).

**Q.** Please clarify a few things for me concerning operating systems. I don't understand what the difference is between a "regular" operating system and 32-bit operating system. I get the impression that DOS is a 16-bit operating system, yet Windows 3.1—which rides atop DOS—is a 32-bit platform. Okay, that I might be able to handle, but now I'm flooded with "Chicago," Win95, and Warp which may or may not be 32-bit. What's happening?

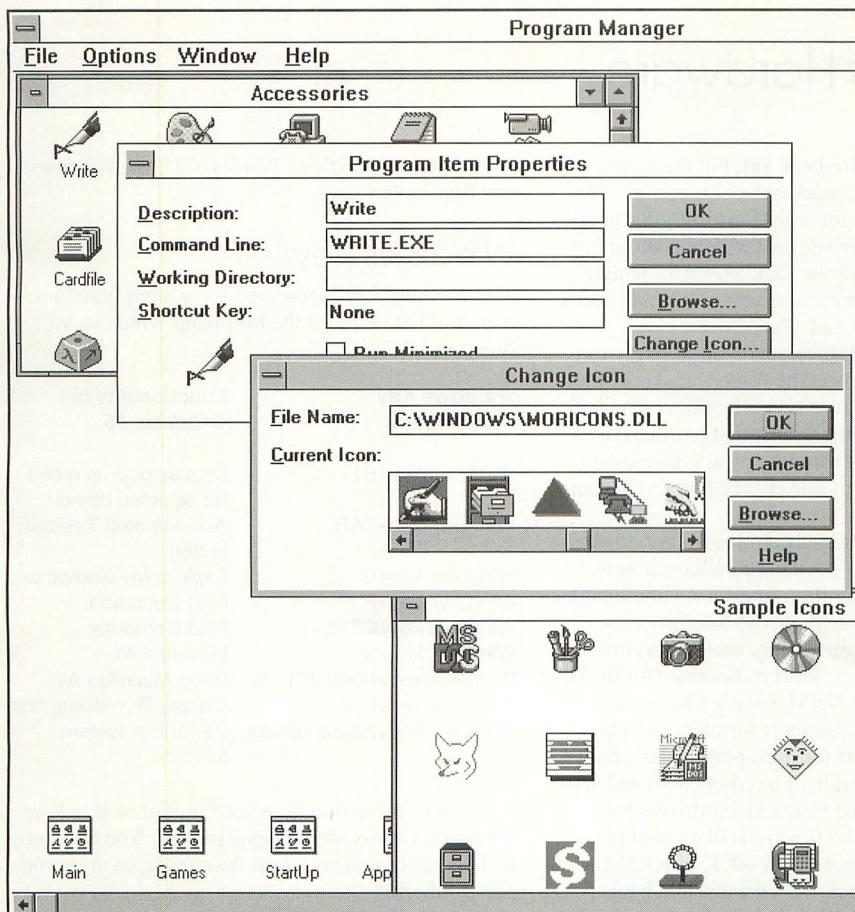
you're using, pressing Alt-V will always bring up the View menu that'll let you get back home by clicking on the mouse Full Screen option (Fig. 3).

## Is It 16- or 32-bits?

**Q.** Please clarify a few things for me concerning operating systems. I don't understand what the difference is between a "regular" operating system and a 32-bit operating system. I get the impression that DOS is a 16-bit operating system, yet Windows 3.1—which rides atop DOS—is a 32-bit platform. Okay, that I might be able to handle, but now I'm flooded with "Chicago," Win95 and OS/2 Warp which may or may not be a 32-bit operating system. What's happening?—Mary Cutler, St. Paul, MN

**A.** Let's start with a bit of history. The original PC (circa 1980) had an eight-bit bus. The PC-AT (1984) expanded the bus to 16 bits, where it remained until Intel introduced its 386 and 486 chips that finally gave us access to a 32-bit highway. Then, there's the Pentium, which has a 64-bit-wide bus. Generally, the wider the bus, the faster the PC. Now to make the hardware work, you need software support, which is essentially an operating system.

DOS was the first operating system on the scene and is still the most popular. Windows 3.1 isn't an operating system in itself. Rather, it's a graphics extension of DOS. Win95, on the other hand, is a stand-alone operating system that doesn't need DOS to work, but it will support DOS applications through emulation. The



**User's Tip:** Are you bored with the application icons in your Program Manager? Well, they're simple enough to change. Simply click on the icon you want to change, choose Properties from the File menu and select the Change Icon option. Now in the File Name dialog box, type C:\windows\progman.exe. This will give you access to 46 icons of the type you see in the top row of the Sample Icons window here. If you don't find what you're looking for, type C:\windows\moricons.dll instead. This file contains more than 100 cool icons, like those shown in the last two lines. Have fun!—Paul Weisberg, Los Angeles

same applies for "Chicago" (officially called Windows NT) and OS/2 Warp, the last from IBM. With the exception of DOS, each of these operating systems has the capability to manage a 32-bit bus. However, it's up to the application to take advantage of the available bus width. The problem here is that for the program to be compatible with older systems, it must default to the lowest common denominator, which is eight bits.

Programs written for Windows are usually 16 bits so that they can run on 286 machines. More-powerful Windows applications, like AutoCAD, use the full 32 bits available in 386 and 486 systems. Presently, I know of no applications that take advantage of the Pentium's 64-bit bus. So, in answer to your question, it's not the operating system, but the application, that determines how many bits are used.

## Lost Chains Rattle Him

Q. Whenever I leave Windows and then run either the Norton Utilities Disk Doc-

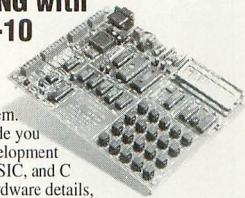
tor or CHDKSK, I find lost chains—even though I'm careful to close all applications and exit Windows using File/Exit. What gives?—Eric Varney, Phoenix, AZ

A. It sounds like you're running a DOS application from a Windows screen that's messing up your file allocation table (FAT). Some DOS programs, like Microsoft Diagnostics (MSD), are designed for use when the files on the disk are in an unchanged state (that is, when they aren't open). When a file is open, it's probably changing, and DOS will update the FAT and the directory structure to reflect the changes.

If you run MSD when other programs are running, files might still be open, and changing. This is especially true of applications that run in the background. The culprit could even be a TSR that's making changes to open files. The only way to find the offender is to disable your applications one by one, while exiting Windows and checking for lost chains at each step, until the problem cures.

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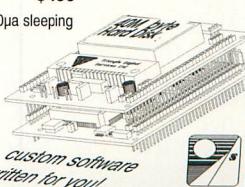
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## GUI Guts

# Windows Hardware

**Windows 95 isn't quite here yet**, but there are already signs of it in the marketplace. If you've seen the IntelliPoint driver for any Microsoft pointing device, the IntelliType driver for the new Natural keyboard or the new Windows Task Manager, which also comes with the keyboard, you've already had a glimpse at the new face of Windows.

The first superficial difference you're likely to notice in these products is the folder-tab convention that lets you select feature sets. They're convenient, but these tabs smack of a revisionist return to modes and could be used this way by unwary developers. I'm going to give tabs a fair chance before I say any more about them.

There are many more substantive improvements promised for Windows 95. These include: a new, though comfortably familiar, interface; simultaneous continued support for key current-interface elements; preemptive multitasking; scalability; improved crash protection; local re-booting (for un-killable applications like NetManage's *Custom* and *Newt*); long filenames; support for plug-and-play; SCSI layer and support for mini-port drivers; built-in PCMCIA drivers, built-in Internet client and server for PPP connections; faster 32-bit drivers for printing and multimedia functions like video playback and CD-ROM; more than 600K of RAM for DOS applications; quick file viewers; and backwards-compatibility for Windows 3.1-era applications, drivers and hardware.

There are tons of MIS support, among them: privileges; resource registry; security; built-in networking, including a 32-bit Novell *NetWare* client; and much more. MS *Exchange*, a communications, scheduling and groupware data-management client, with replication features reminiscent of *Lotus Notes*, is also to be included. Windows 95 will utilize more-powerful systems, additional memory and 32-bit code to run applications faster, too.

If you don't count the mouse, this is also the first version of Windows to support Windows-specific hardware. In addition to an advanced ergonomic design, the Microsoft Natural Keyboard includes two

keys that are specific to Windows 95: the Windows and Application keys.

### Windows Key

The Windows key is reserved for system functions. A partial list includes the following Windows 95 functions:

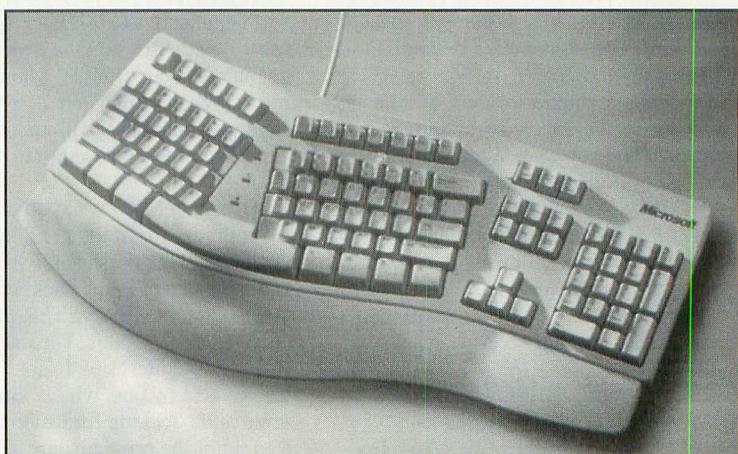
Windows Key Combination	Functionality in Windows 95
Windows key+F1	Display pop-up menu for selected object.
Windows key+TAB	Activate next Taskbar button
Windows key+E	Explore My Computer
Windows key+F	Find Document
Windows key+CTRL+F	Find Computer
Windows key+M	Minimize All
Windows key+M+SHIFT	Undo Minimize All
Windows key+R	Display Run dialog box
Windows key+Pause (Break)	Perform a system function

Some of these functions are familiar to Windows 3.1 users. Others are self-explanatory. The reference to Taskbar buttons is worth describing, as are a couple of others.

The new Taskbar is a button bar, and one feature it provides is an alternative to the Alt+Tab task-switching feature in Windows. Alt+Tab currently switches tasks blindly and gives you no idea where the application you're seeking is located in the task list. This is changed in Win 95. The new interface produces a road map of icons when you begin to switch tasks. The map displays your current task in relation to all others and shows you just how far you have to go to reach your destination.

The Windows+Tab key alternative to the familiar Alt+Tab method uses the Taskbar. This also provides a graphical view because the Taskbar includes an array of buttons that represent all open windows. These buttons also can be pushed, either to access

Microsoft's Natural Keyboard.



open windows directly or to open minimized windows—just as icons have been double-clicked in previous versions of *Windows*.

Explore My Computer relates to new interface features. The default browsing model for *Win 95* is called My Computer. Basically it's a more-intuitive replacement for the *Windows* File Manager that bears a close resemblance to the interface for the Macintosh operating system. *Windows* Explorer is a more-complicated dual-pane model that puts a hierarchical view alongside file folders. It bears a superficial similarity to the current File Manager. Explore My Computer brings up this Explorer interface.

Finally, the Find Computer shortcut brings up a dialog to locate network servers. It's similar in functionality to the Connect Network Drive menu item in the *Windows for Workgroups* File Manager.

When used in *Windows* or *Windows for Workgroups*, the Windows key can open the new Task Manager utility that comes with the Natural Keyboard. This is a version of the *Windows 95* Task Manager, which replaces the old *Windows* TaskMan, which is now known as the Task List in *Win 95* new-speak.

## Application Key

Application key function depends, in part, on implementation by developers, but support for this key also varies among Microsoft operating systems. In *Windows 95*, it opens a context menu on selection, with or without a driver. In *Windows 3.1* and *Windows NT*, it supports system functions only with Version 1.1 of the IntelliType driver that will ship with release of *Windows 95*.

With the driver, the key invokes a Shift+F10 context menu. The IntelliType 1.1 software will simulate a right-button mouse click if no other application hooks the 5D virtual-key code generated by the keyboard. Without the driver, *Windows* still reports a 5D virtual-key code, which means that applications can enable functionality if they trap the code.

In all cases, the Application key's primary function will be to bring up a context menu at the selection pointer or mouse pointer. This is the same functionality that's now provided by a right-button mouse click in some applications, including most major office-suite products.

The IntelliType 1.1 driver isn't required for use of these new keys in *Win 95*. It supports the buttons directly. Rather, IntelliType was developed to enhance the functionality of keyboards with *Windows 3.1* and *Windows NT 3.5*. There are some other features that it supports, though. One of these is a mouse substitute that lets you

use the keyboard for pointing control without other assistance.

Pointing-device controls were designed into the Natural's numeric keypad for the physically challenged. However, focus groups and user testing convinced Microsoft to omit a pointing device from this product. So the built-in mouse feature is likely to be of use to others, too. You might well want to use it just to sit back away from your desk and move your pointer without having to stretch out to your mouse. It can be essential if you're a portable-computer user who has just one PS/2 port for either a keyboard or mouse but not both. The keyboard can do double duty if you're in this predicament.

Unfortunately, these mouse-like features aren't at all well-documented. One is entirely undocumented. Enabling the feature is easy. There are two boxes under the IntelliType's Keyboard Control tab. However, this doesn't tell you how to use the keypad keys as mouse buttons. For this, you must open IntelliType Help and select "Pointer Navigation with the Keyboard" from the Contents menu to find the tricky way the buttons work.

The 5 key represents a single click, the keypad + key a double-click. Click-lock is enabled by the 0 key and disabled by the . key. The /, \* and – keys assign primary, both or secondary keys, respectively, to the 5, +, 0 and . keys. The system is a little cumbersome, but it was designed to facilitate people who have extremely limited keyboarding abilities.

The one undocumented keyboard feature is the function of the Shift key in cursor control. IntelliType has a box that enables a Fast Move feature. Clicking on it lets you use the Ctrl key in combination with the cursor keys to move the pointer in large jumps. However, no mention is made to the effect that the Shift key has just the opposite effect. It provides precision movement with small steps.

Incidentally, *Windows* development has become so specialized that the keyboard's product manager wasn't aware that his product's Ctrl convention is contrary to a similar one used elsewhere in *Windows*. I pointed out to him that if you use the cursor keys to control sizing or window movement from a window's control menu, it's the Ctrl—not the Shift—key that provides precision movement. Perhaps, one of these conventions will be changed to conform to the other in a future release.

## Ergonomics

Beyond its special keys, the principal benefits of the Microsoft Natural keyboard are ergonomic. Outward rotation of the keys, their upward slope, division of the keys into right and left sides, separation of

the sides and their upward tilt toward the center all contribute to a healthier man-machine relationship. So does an unusual front-edge elevation device that levels the keyboard, rather than inclines it to the rear as do most conventional keyboards. Raising the front edge of the keyboard is intended to level the wrists if this is required by the keyboard's height.

These changes are all intended to eliminate undesirable angles and bends in the joints that are stressed during typing. The keyboard also has a front extension on which you can rest your wrists when you aren't typing.

The Natural Keyboard's ergonomic features were developed by Microsoft in conjunction with the Joyce Institute of Seattle ergonomic think tank. However, the principles the company employed are similar in many ways to ideas I first heard from Tony Hodges, an early ergonomic-keyboard innovator. He convinced me of their value over the telephone with a little experiment.

For the experiment, Tony had me rapidly open and close both fists for a couple of minutes. He simultaneously had me twist one wrist exactly as I would hold it while typing on a conventional flat keyboard. He had me hold my other hand straight out from the wrist with a relaxed upward rotation of the thumb. To be frank, I didn't notice any difference at the time.

That night, however, I awoke from pain in one wrist. At first, I was confused. Similar pains have plagued me since I was a teenager. I tried to recall which kind of tool I'd handled the previous day, but I couldn't remember having done any of the hammering or screw driving that would typically irritate my carpal tunnel. Suddenly, the experiment came back to me. The hand that hurt was the one that had been contorted. I've been a believer in ergonomic keyboards ever since.

## The Competition

That was several years ago. Now these benefits are widely accepted, and several companies produce ergonomic keyboards to satisfy the demand. Some of those competing keyboards may one day also sport the new *Windows* buttons. If they do, they'll be able to offer them with the IntelliType driver should they so choose. Microsoft will license it to both OEMs and manufacturers.

Genovation is likely to be the first competitor to offer a product that supports *Windows* keys. The programmable keys of it's forthcoming ergonomic entry (which I hope to cover as soon as it's available) should be amenable to many applications, including *Win 95*. However, there's no indication as to whether or not the product



Reveal's Model KB-7061 ergonomic keyboard.

will come with IntelliType or another driver to support other versions of *Windows*. It may instead rely on the user to simply program equivalent functions as required.

Keyboards that have similarities to Microsoft's Natural keyboard are available from other vendors. Using one of them is not only a question of whether you can do without the extra keys, but also whether other characteristics of the design might reduce your *Windows* productivity.

Reveal Computer Products offers a somewhat simpler keyboard that shares the Natural Keyboard's right- and left-hand separation and outward rotation. It lacks the upward tilt, as well as the new keys. In place of those new keys, the Model KB-7061 replaces the Natural's central spacebar with a pair of right- and left-hand space bars. It also has a pair of conventional fold up legs that provide elevation toward the rear.

The KB-7061 lacks a wrist rest as well, but this isn't a problem during typing. The wrists should be held parallel above the keyboard while typing to keep them straight to eliminate the sharp bend that occurs when they're rested on a table or wrist rest. Microsoft warns against using its rest only while not typing. A keyboard like this model from Reveal provides a reasonable ergonomic alternative that, while lacking special *Windows* support, also has no design elements that might interfere with efficiency.

Although both the Microsoft and Reveal keyboards provide relief from repetitive stress, there are a couple of things that neither can do because they aren't adjustable. A fixed form obviates several strategies that can be achieved with an adjustable keyboard. For example, an adjustable keyboard permits you to gradually attune yourself to radical shape

changes and thereby increase the amount of ergonomic benefit over time while minimizing culture shock.

Adjustability permits personal customization to the most-comfortable shape for individual body geometries. And an adjustable keyboard can be varied to provide occasional relief from a fixed position. For example, if you're constantly typing, you could change the tilt one time and the rotation another time to vary the location of stresses.

Several companies address this issue with keyboards that aren't specifically designed to work with *Windows*. Changes and compromises inherent in these designs may have an impact on how well they support the GUI interface. Key Tronic's FlexPro has one of the more-radical adjustable designs.

FlexPro consists of a full conventional 101-key keyboard with numeric keypad and an adjoining cluster of navigation keys. One significant difference you may note is that the function keys are arrayed vertically along the left side as they were on the original IBM AT keyboard. FlexPro has the entire dozen keys that are now standard.

Where the function keys are on most keyboards, there is a large centrally-mounted button that serves as a keyboard release latch. When you press this button, the center of the keyboard pops up. You can then adjust tilt angle with a knob mounted on the keyboard's right end. Adjustment permits very steep inclinations, up to 25°. It also controls rotation. Hence, the two adjustments are dependent.

Because the keys are mounted in a fixed keyboard, the degree of rotation is rather limited, requiring you to keep your hands fairly close to the center, much like on a conventional keyboard. However,

steep tilt adjustment can eliminate wrist cramping and relieve stress just as effectively as separating the two sides and/or outwardly rotating them.

There are no Windows or Application keys on FlexPro, but there are several enhancements. In the raised position, the two spacebars on this keyboard can be pressed conventionally or on their ends to operate as four buttons. A special feature lets you assign your choice of Backspace, Enter and Space functions to any of them.

Several other keys have alternative configurations, and the numeric keypad includes its own Backspace key. FlexPro also comes with a pair of elevated hand rests to provide support during operation.

FlexPro has one more enhancement of special interest to the *Windows* user. A column of alternate Ctrl, Shift and Caps Lock keys is arranged in the pattern required by the old *WordStar* control diamond. These keys were apparently designed to support software that uses or requires these commands. The column is just to the right of the normal keys, in a position where it doesn't tilt.

Unfortunately, two other keys are part of this detached key column, one of them the Esc key. Considering the frequency with which you're likely to use Esc to cancel operations and close windows and dialogs, this could be a disadvantage. Making the Esc key a spacebar option would facilitate *Windows* much better than having another Enter key there.

I have a few general gripes with FlexPro. One is that the raised portion of the keyboard has a mushy bounce to it when elevated. The other is that it isn't possible to tilt the keys to elevations as low as that of the Natural Keyboard. This might make it more difficult for some users to adjust to their unfamiliar positions. Both problems seem due to slack in the mechanism that raises the keys.

Finally, this is the only keyboard I tested that won't attach to a PS/2-type mini-DIN connector, which means you can't use it with many desktop machines or with most portables without purchasing another part. The adapter isn't expensive, but obtaining one is an unwarranted inconvenience, particularly when you consider that even very inexpensive keyboards provide them.

The Lexmark Select-Ease keyboard has a much simpler design than FlexPro, even though it permits more-radical geometry. You can set Select-Ease to a variety of slopes, tilts and rotations with multi-position legs and a clever ball joint that lets you control all angles with a single knob.

You can also physically split Select-Ease into two half-keyboards that are connected only by a cable. The distance you can separate them is limited by the length



Lexmark's Select-Ease ergonomic keyboard.

of the cable that electrically joins them. However, it's far enough to accommodate extremely wide typing positions. The closest thing I've seen to this was a \$2,000 typing chair I ran across a couple of years ago that had half a keyboard mounted at the end of each arm.

Lexmark's keyboard is designed to remain on the desktop, but their legs still adjust for a variety of tilts up to 20°, and slopes up to 17°. When the halves are connected at the rear, the ball joint permits rotation angles up to 90°. You can also cheat and position it at steeper tilt angles than are supported by the legs.

Three more productivity features are built into the Select-Ease: a port for an optional numeric keypad, dual inverted cursor-T's, and Erase-Ease. The last is essentially a subset of the spacebar configuration options available on FlexPro. It lets you selectively set the split spacebar to work in the ordinary manner or as a spacebar on either half and a backspace on the other half. If you backspace frequently, you may appreciate no longer having to spend time reaching off the home row for the key to do this.

Lexmark's keyboard is the lightest and smallest of these keyboards. This can be an advantage, but it comes at the expense of many data-processing keys, including the entire numeric keypad. Lamentably, light weight also contributes to a little skittishness when the halves are separated.

Select-Ease works best on a surface that provides some traction for its feet. Lexmark includes a pair of resilient wrist rests with this keyboard. You should also notice a familiar office-quality sense of response, sound and substance in this product. (Lexmark makes IBM keyboards and is 10% owned by the company.)

I must admit that the lack of a keypad gave me an initial aversion to this keyboard, but there's a lot to be said for its simple and sturdy approach to a flexible

design. And since I do mostly word processing, the addition of a couple of programmable keys I could use to emulate the new Windows and Application keys would probably elevate it to my first choice for a *Windows* keyboard. Even without them, it's very close.

The deciding factor on these new keys is whether or not enough software developers write programs that use the Application key to make it a significant advantage. This will occur only if many keyboards incorporate the feature. The last time something like this occurred was when IBM revamped the AT keyboard with function keys arrayed across the top, rather than down the side and it's Ctrl and Caps Lock keys reversed. That resulted in major changes in software design and drove the final nail in MicroPro's *WordStar* leadership coffin.

Microsoft may now have enough clout in the marketplace to bring about a similar change. The company can also use its operating-system designs to force the issue by the degree to which they make the Windows key irresistibly attractive.

## Which To Buy?

Ever since Tony Hodges turned me into a convert, I've been an advocate of ergonomic keyboard design. I'm delighted that Microsoft has had the foresight to put ergonomic features into its keyboard, rather than to just tie it into *Windows* with some special keys. Having both features gives the Natural Keyboard a definite advantage over keyboards that have only one of the two. However, of the two features, ergonomics is the more important. There's little point to having a more-efficient keyboard if you can no longer type because of repetitive-stress injuries.

The foregoing said, you still have one more thing to consider. Different users have different ergonomic needs. Ergo-

nomic needs are based on general health, other injury-susceptibility factors, such as genetic predisposition, how much keyboarding you do and personal comfort preferences. There's no point in paying for more keyboard than you really need. If you can get by with a basic keyboard that has a few ergonomic features, the Reveal KB7061 might be for you. It's seems sturdy enough, and it has an estimated street price of about \$60.

I think Microsoft also took ergonomic and price tradeoffs into consideration in building its keyboard. It has a good combination of simple, yet effective, ergonomic features designed for a hypothetical average user. It's an intermediate, not radical, design. Nevertheless, it may have an ideal, or nearly ideal, geometry for you if you fit its design profile well. The Natural is also a well-made product with a low mass-market price that will appeal to many buyers. Microsoft expects it to sell for less than \$100.

On the other hand, so to speak, gradual accumulation of damage from stress injuries is insidious. If you spend a lot of time with a keyboard or already suffer from a stress-related injury, it's not worth taking chances. Don't hesitate to pay more for a keyboard that can be adjusted if it produces less stress. For a list price of \$179, Lexmark's Select-Ease provides a high-quality word-processing keyboard. It's not quite as well-suited to data processing, particularly without the optional numeric keypad.

FlexPro also offers quite a bit of, well, flexibility for its recently lowered \$299 list price. It permits radical configurations and has a full complement of both word-processing and data-processing keys.

The one thing that I truly regret all of these manufacturers left out of their designs is a pointing device. Adding a pointer would create some complications, such as which side to put it on a split keyboard, how to provide the extra wires that are required and what kinds of connectors to provide. Nevertheless, I've grown so accustomed to the pointing sticks that come on the IBM ThinkPad and Gateway 2000 Liberty notebook computers I use, that they're sorely missed.

Microsoft's research disclosed that only 20% of the potential ergonomic-keyboard market expressed an interest in a pointing stick. So what? I didn't, either, when I saw it. It took me several weeks to accommodate myself to it. But now I don't want to go back to a trackball.

There was no single pointing solution that attracted a broad spectrum of users. So Microsoft abandoned a central trackball design that it tried in some prototypes. Still, Microsoft could have provided an upgrade socket or some other means of

adding a pointer of the user's choice. Some pointer would have been better than none. Lexmark makes the TrackPoint II keyboards for IBM. So, perhaps there's future hope on this front.

## Internet Update

Last month, I promised to look at NetCom's *NetCruiser*. NetCom is one of the large national service providers that are attracting droves of users to the Internet. Its good deal is a big attraction. NetCom gives access to the entire Internet for only a couple of bucks an hour. On average, it's really less.

The monthly fee of about \$20 includes 40 hours of on-line connect time. Furthermore, several hours from midnight until early morning are free every day, and so are all the hours over every weekend. I'm not sure about holidays, but some of these may be included, too. In all, you can get about 400 hours a month for your \$20.00.

With the very few regional exceptions, these costs compare favorably with almost any Internet provider. The rates beat even the new lower rates offered by CompuServe and other on-line services that offer Internet e-mail and newsgroup services. The rates are much more attractive than those offered by some of the other national Internet providers. You might pay \$8 an hour for some competitors that provide access to distant nodes through a toll-free number. NetCom uses a network of local nodes you can call either free or for a small message-unit charge from a large area of the country.

In addition to connection, NetCom also gives the software you need to access the Internet. All the most-important client applications are provided, including e-mail, Gopher, telnet, FTP and World Wide Web browser. So are convenient utilities like Finger and the Internet Site Chooser, which is a pull-down site list and a map that you can click on to find continental-US Internet nodes.

NetCom software is fittingly designed for the most part. Web Browser works quite well and includes bookmarks, a source viewer and other basic features. NetCom's Internet Relay Chat (IRC) client interface isn't as full-featured as (but in some ways, it's easier to use than) the WSIRC program I favor on my Earthlink PPP account.

There's one convention I hate that I've noticed is common to many Internet applications. If you accidentally press Alt+F4, *NetCruiser* immediately closes, no matter what's in progress. It sorely needs a confirmation box. Otherwise, if NetCom would clean up the way some IRC commands work from the command prompt, add access to a few others that seem to be

mysteriously lacking and provide universal keystroke commands, *NetCruiser* would really start to cook.

Of course, being that it doesn't now have all these things, I have to take it to task. As for keystrokes, this software is the most completely devoid of such support I've ever seen. You can't even use Ctrl+C to copy. You must pull down the Edit menu. I get annoyed when a program still uses the Windows 3.0 shortcut keys. This level of omission is a very tedious *faux pas*.

There's no written documentation for *NetCruiser*. However, the company recommends the Sybex book, *Access The Internet*, by David Peal as it's unofficial manual. It's essential for finding certain features.

For example, the program has an address-book feature that's easy to use once you find it. The problem is that when addresses come up during an e-mail session, the buttons to access the editing features are absent. They're accessed through a separate menu item hidden under Internet. Internet? I thought that's what the whole enchilada was about. Silly me. Fortunately, this feature is easy to find by quickly scanning the book's illustrations, and *Access the Internet* makes the architecture clear.

The book also provides a hint that the software supports signature files. You'd never know it otherwise. But simply adding a text file called MAIL.SIG to your NetCom directory does the trick.

Finally, the book includes the start-up software. There are a lot of ways you can do the math, but what it comes down to is that the book ends up costing you about \$5 more than a NetCom account without one. If you're going to get NetCom, get the book first. What the software really needs, though, is a single button within the e-mail feature that brings up the hidden address-book features. It also needs an easy way to capture addresses from your mail.

To copy an address in *NetCruiser*, you have to do it by hand. Addresses and text of incoming mail are just a couple of the little things in *NetCruiser* that have dead Edit menus. If *NetCruiser* has an automatic button-powered capture like the one in CompuServe's WinCIM, it's buried somewhere, too.

*NetCruiser* has some other flaws. Despite an interface with real potential, NetCom can make it very difficult for the software to cruise over to IRC. I was almost never able to get onto the NetCom IRC host that provides a private NetCom chat area. Only once or twice was the EFnet available and able to connect me to IRC at large.

Getting onto the distant university server

I usually use was often not much easier. It frequently informed me that I was banned. In a similar way, some servers reject NetCom connections as "unauthorized" from time to time, while cheerfully making the connections at others. The one common thread seems to be that servers behave consistently within any single session.

As far as I know, the only thing that changes between NetCom sessions is your Internet IP address. NetCom allocates them dynamically to users from a common pool. I strongly suspect that some of the dynamic IP addresses have been contaminated by unruly members. I don't know how else to explain why I'm sometimes unwelcome when I try to get on-line from NetCom but never from my regional account at Earthlink, which allocates fixed IP addresses to its users.

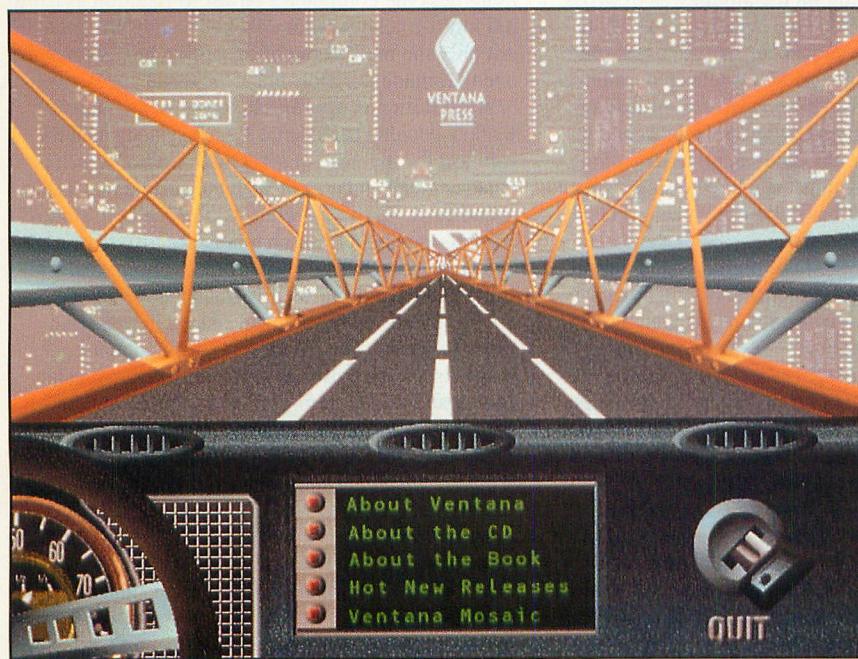
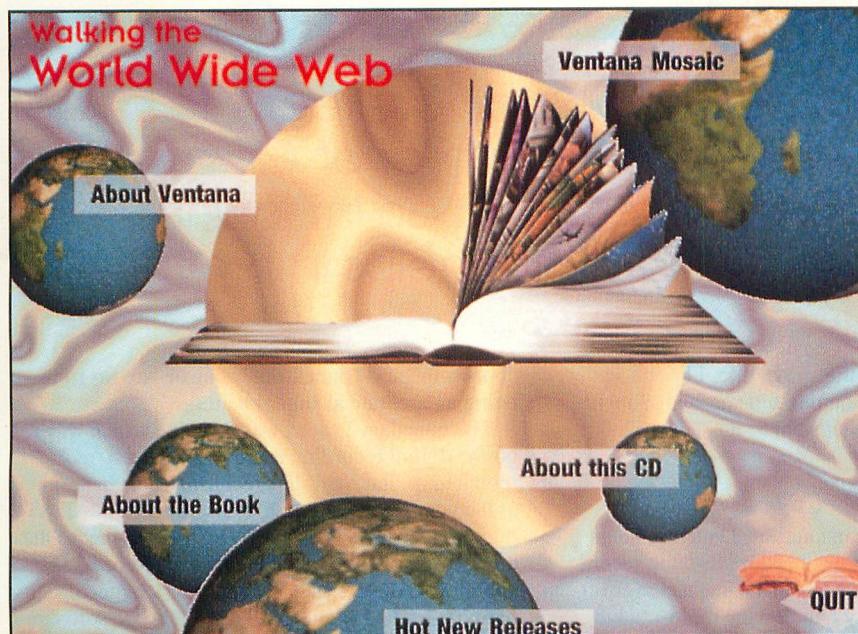
Leaving NetCom and logging back on often solves these IRC problems. However, getting back onto NetCom frequently involves another problem you won't want to face. In the last few months, usage seems to be growing faster than the ability of the system to handle it. I've had to wait 10 or 15 minutes to re-initiate the logon process three or four times before getting on-line. This sometimes occurs with my local Earthlink account, but it doesn't seem to do so as often.

Then there's the little trick that *NetCruiser* plays with my user name and password. There are times when it repeatedly says one or the other is invalid and refuses to connect me. It doesn't matter how carefully I enter them. I originally thought I must be entering my password incorrectly. It's obscured, and I couldn't know for sure. Then I tried changing just my user name and it worked. I could plainly see that I'd spelled it exactly the same both times. I hadn't touched the password. Now, I just want to punch NetCom when it does that.

Disconnects, can also sometimes be a problem while using *NetCruiser*. I don't get disconnected from Earthlink with anything like the frequency with which I'm unceremoniously dumped by NetCom. From what I see on-line, NetCom customers using the shell interface seem to fare better. There are plenty of them on IRC, and while they crash, the frequency of those crashes seems no worse than average, given the occasional tenuousness of IRC.

On the other hand, there are times when connections are trouble-free for long periods. This leads me to suspect *NetCruiser* could be involved, but probably only as a contributing factor.

*NetCruiser*'s e-mail client has a more-serious problem. Given the frequency with which users typically need to access it, you might expect e-mail to be one of the



"Walking the World" (top) and "Roadside Attraction" (bottom) screens on the Internet under NetCom's *NetCruiser*.

better-supported functions. As I discovered, though, there's no buffering for letters you write. If the NetCom mail server fails and a message you send doesn't get out, you lose all your work because there's no automatic retention.

You can save it yourself first, but you shouldn't have to do this unless it's just to keep you on-line a couple of extra minutes. The first time it occurs, of course, you get to spend lots of extra minutes on-line while you once again compose your reply.

Not all of *NetCruiser*'s problems are likely to be solved as simply as saving each outgoing message (whether or not you want a file copy). Perhaps the program's most-intrinsic failing is that none of its features are accessible off-line. Before you can add anything to the e-mail address book, browse for a Web page stored on your own hard disk or create a letter, you must log onto NetCom.

Aside from the unnecessary connect costs involved, the process of connecting to NetCom can take many times longer

than it does to perform many trivial tasks. Unless you do all your housekeeping in the middle of the night or on weekends, it can eat up some of the advantage NetCom enjoys from its lower rates.

In all other ways, NetCom has a lot more going for it than against it. Certainly, the price is hard to beat. The *NetCruiser* software is only in release 1.51 at this writing, and it's already very good in many respects. When new software is ready, you won't even have to order it. The system downloads it automatically when you log on with an older version. Supposedly, another version is nearing completion, and I'm eager to report its improvements.

### Products Mentioned

Reveal KB-7061, \$60 (street)

**Reveal Computer Products**

6045 Variel Ave.

Woodland Hills, CA 91367

Tel.: 818-704-6300

CIRCLE NO. 100 ON FREE INFORMATION CARD

Natural Keyboard, \$100 (street)

**Microsoft Corp.**

One Microsoft Way

Redmond, WA 98052

Tel.: 206-882-8080

CIRCLE NO. 101 ON FREE INFORMATION CARD

Key Tronic FlexPro, \$299

**Key Tronic Corp.**

Box 14687

Spokane, WA 99214

Tel.: 800-262-6006 or 509-928-8000

CIRCLE NO. 102 ON FREE INFORMATION CARD

Lexmark Select-Ease, \$179

**Lexmark International, Inc.**

740 New Circle Rd. NW

Lexington, KY 40511

Tel.: 800-438-2468 or 606-232-2000

CIRCLE NO. 103 ON FREE INFORMATION CARD

*NetCruiser*

**NetCom**

3031 Tisch Way, 2nd. Fl.

San Jose, CA 95128

Tel.: 800-353-6600

CIRCLE NO. 104 ON FREE INFORMATION CARD



By Tom Benford

## Multimedia

# Multi-Track digital recording directly to a hard drive, the absurd humor of *Monty Python's Flying Circus* and an intriguing interactive CD-ROM that helps improve camcorder techniques

As you can see from the above title, I have a variety of neat stuff to report on this time around. So without further adieu, I'll get right to it.

### Quad Studio

When I recorded my first audio CD album, *Some Things I've Done*, I didn't need multi-track recording capabilities because the MIDI sequencing software I used effectively handled the multi-tracking chores. Since everything on the album was in MIDI format, it was a straightforward matter to do all mixing and effects via the sequencer software and route the output from my General MIDI tone generator directly to a DAT recorder to send off for mastering. Now that I'm working on my second album and intend to have analog guitar (and vocal) tracks, along with the MIDI sounds, multi-track recording capabilities are an area that has earned my keen interest of late.

After working with the pure digital sound output of MIDI equipment, DAT recorders and CD-ROMs, I've become somewhat of a snob in the area of pristine audio. With its attendant hiss, tape recording just doesn't cut it anymore for me. Sure, I use a multi-track cassette recorder as a musical sketch pad for "roughing out" the vocal and guitar parts of song ideas. But when it comes to putting tracks down for posterity, digital is the only way to fly.

In addition to the ever-present hiss, a significant amount of signal loss occurs when layering tracks or "ping-ponging" tracks back and forth across channels during the mixing process with tape. Another fault of analog tape recording is that it's a less-than-precise medium for editing because even the best

"punch-in" and "punch-out" controls are far from being as accurate as digital editing.

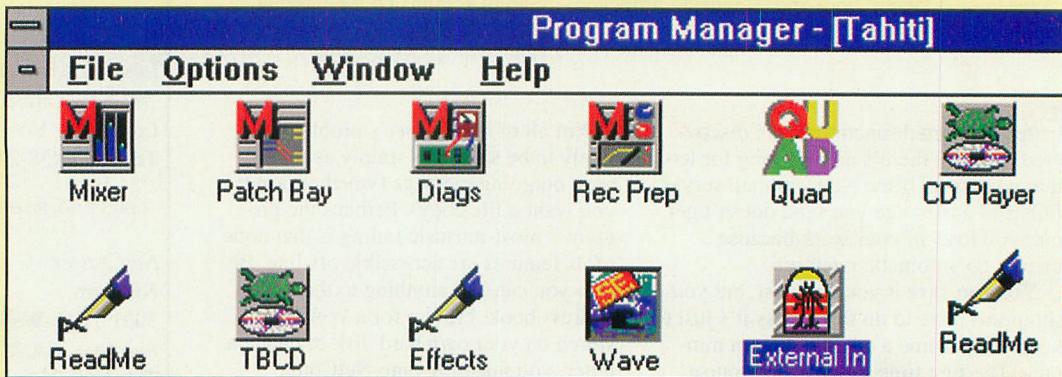
The quandary I faced was deciding which way to go the digital recording route. A dedicated rack-mounted digital hard-disk recording system would, at the very least, cost more than \$1,500. An ADAT digital recorder, which uses VHS tape to record the digital signal, costs in the neighborhood of \$3,000 and more. Alternatively, I could use a large-capacity hard drive in a PC and get the appropriate software to harness the computer's power to function as a digital multi-track recording deck. The last proved to be not only the most-economical option but, for me, the one that made the most practical sense.

After doing an appropriate bit of investigative work, I decided that Turtle Beach systems had the solution for my needs in its Quad Studio, which retails for \$499 and comes with the company's Tahiti sound card. With this setup, you're ready to start recording as soon as you complete the installation.

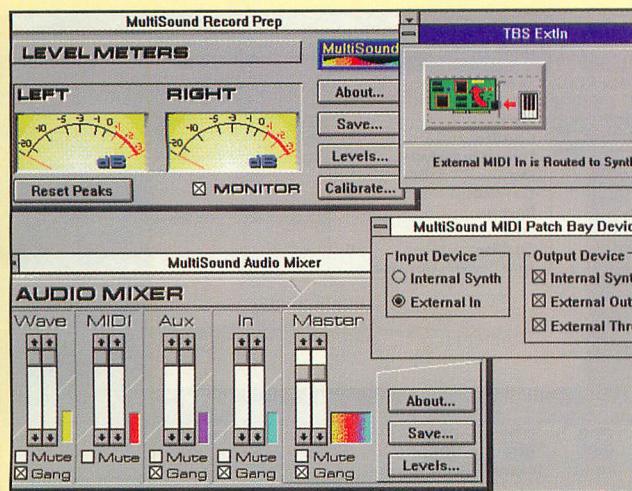
The 3/4-length Tahiti sound card requires a 16-bit slot and a hard drive with 16-ms or faster access time to handle the audio data stream in real-time while recording. Installation is simply a matter of plugging the card into an available expansion slot and closing the system-unit case. The default settings will work in the majority of installations, even if you have lots of other peripherals installed.

Software installation is done from *Windows*.

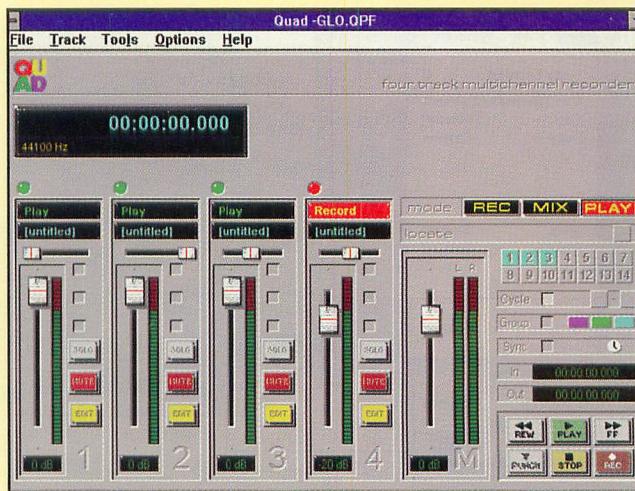
You can get the Quad software alone for \$299, but you'll need one of Turtle Beach's sound cards with Hurricane architecture to use it. Quad software won't work with any sound card other than one made by Turtle Beach. The reason is that other sound cards use DMA-based architecture for record-



The Quad Studio installation program provides all the applications you'll need to record, edit, play back, mix and add special effects to PC audio. Additional goodies include two CD player utilities, a software "patch bay" and diagnostic applications to check out the hardware setup.



The various control applets for the Tahiti card are shown here. The graphical displays give all the feedback you need to know or change the configuration of the card, and the analog VU-meter display brings back a touch of nostalgia from pre-digital days.



The layout of the Quad software is very intuitive and fairly self-explanatory, even for total novices to Multi-Track recording. Online help is excellent and always just a mouse click away.



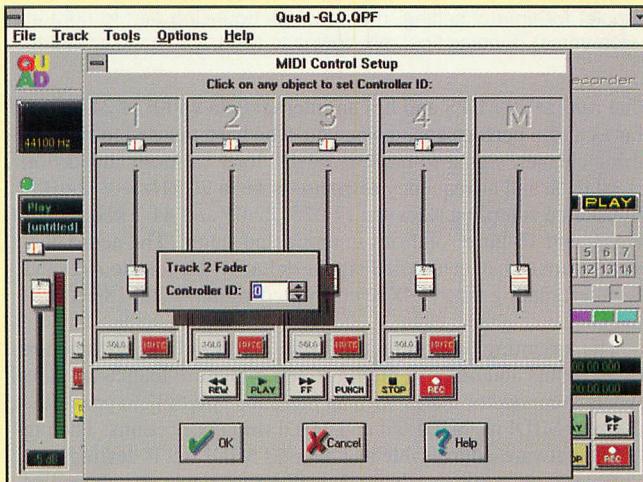
A track offset feature permits you to start playback of all four tracks at different points, a highly useful feature for doing multimedia soundtracks. Tracks can also be faded in and out using the other controls in the program; so the flexibility it gives you is impressive.

ing and playing back audio, whereas Turtle Beach takes its own approach that totally foregoes DMA and uses its proprietary Hurricane technology instead.

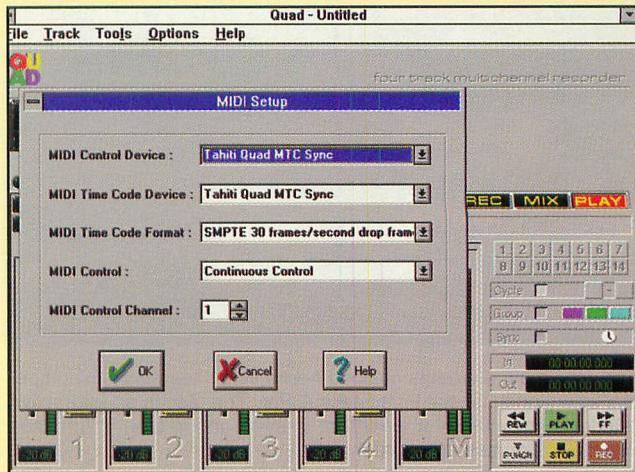
The principal advantage of the Hurricane architecture is that it lets you play and record audio simultaneously, in addition to providing a lot of extra processing horsepower to handle the number-crunching associated with this much audio data. The company claims its Hurricane architecture speeds audio data throughput up to eight times faster than DMA-based solutions.

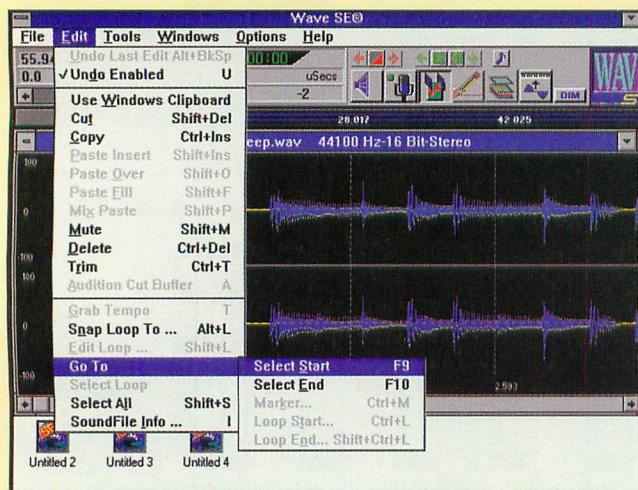
The Tahiti sound card (and the other Turtle Beach products) have a Motorola DSP-56001 digital signal processor on-board

Synchronization options provide both MTC (MIDI Time Code) and SMPTE formats, with variable time/sync resolutions. The SMPTE sync feature makes this a professional-level product that's fully capable of handling production work in broadcast TV, video, multimedia and film soundtrack scenarios. ➤



MIDI controllers can be selected and controlled in real-time during recording and playback from on-screen sliders, one for each track. By providing capabilities to integrate MIDI with analog sources like voice or guitar and converting everything to digital data, the creative power and possibilities provided by Quad Studio are limitless.

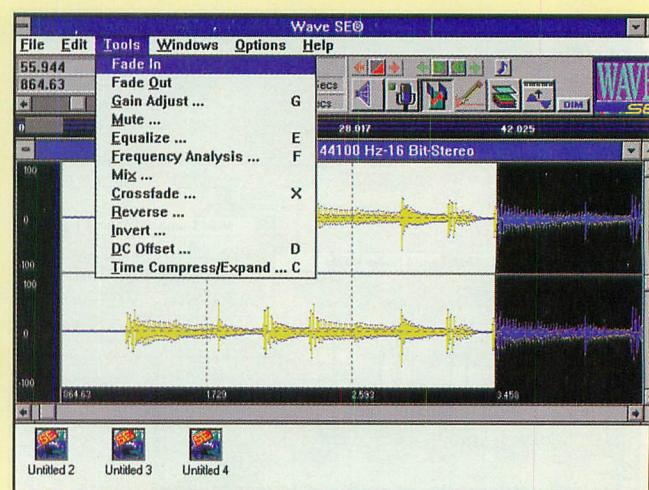




Included in Quad Studio software is a *Wave SE* program that has a rich assortment of sound editing and special effects tools. This application permits extensive manipulation and sculpting of the sound files recorded with the Quad software. After editing or manipulation, the WAV files can be loaded back into the Quad applet for time offsetting, mixing, track bouncing (left to right and vice-versa) or doing final mix-downs to two-track mono or stereo.

that runs at 20 MIPS and has an internal data width of 24 bits. As far as audio performance goes, you'd be hard pressed to find anything cleaner: signal-to-noise is 89 dB, total harmonic distortion is <0.01% and a frequency response is dc to 20 kHz +0/-3 dB. Supported sampling rates are 11.025, 22.05 and 44.1 kHz in both eight- and 16-bit resolutions in mono and stereo. The audio converters are 64X oversampled sigma-delta, 16-bit for the A/D and 8X interpolating filter, 64X oversampled sigma-delta, 18-bit for the D/A.

The mounting bracket on the Tahiti card has line/ mic and auxiliary inputs and outputs, all via stereo miniature telephone jacks. A DB-9 connector mates with an included "pigtail" to provide discrete MIDI in, MIDI out and MIDI thru connections. The pigtail is software-addressable as a second MIDI out if desired. Suffice it to say, the hardware has all bases covered—in spades!



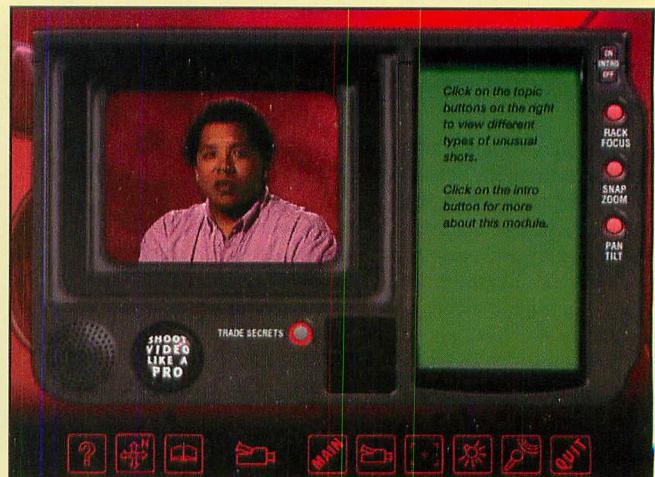
An extensive arsenal of mixing and special-effects tools is provided with *Wave SE*. The graphical display of the sound waves can be zoomed-in for extreme detail or zoomed-out for a more holistic view. The software's capabilities eclipse those of expensive dedicated sound packages.

The Quad is the first affordable system for Windows users. It lets you listen to one, two or three separate tracks while you record another track. For example, you can record a guitar solo over a piece of music while you listen to the rhythm tracks, or you can add narration to a multimedia audio presentation while you listen to the background audio. The capability of clean sound-on-sound and sound-with-sound is what makes this system a real standout and exactly what the doctor ordered for my needs.

When the software is fully installed, a couple of program groups are created, one for the Tahiti hardware and another for the Quad software suite. To clean up my desktop a bit and to keep these interrelated applications grouped together, I combined the contents of both groups. The resulting 12-icon combo group provides me with everything I need to control hardware setup, recording, mixing, editing and adding special effects.



The four main elements of good home video are each given special attention in *Shoot Video Like A Pro*. The disc is an interactive tutorial that provides a wealth of easy-to-understand information on how to improve camcorder skills.



Clicking on the "trade secrets" button brings up full-motion video segments in which the pros share tips and tricks and give advice on how to handle unique conditions during a shoot.



These two screen captures demonstrate the interactive aspects of the program. In the left shot only hard lighting is being used, whereas clicking on the soft light box adds the second light, as seen on the right. With immediate results, you can see the affect such changes have on the subject.

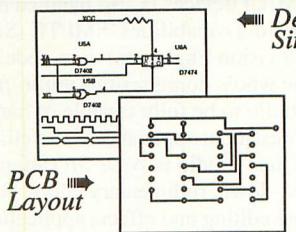
Some late-breaking information and additional information on using the effects controls are provided in the two README documents represented by their respective icons. I'm not a great fan of README files in general, but all three of these are worth the time it takes to scan them because they contain some really useful information and shortcuts for using Quad Studio to fullest advantage.

A Record Prep applet brings up a pair of VU meters you can use to calibrate and adjust recording levels and "peg" the peaks to make sure you're not overloading the signal. A Patch Bay applet lets you assign sources for input and output, and an

External In applet brings up a graphical representation of how MIDI is routed to the card. A Mixer applet provides a relational volume control between sonic elements. The left and right channels can be "ganged" together or muted for Wave, MIDI, Aux, In and Master settings, as desired.

The real magic of Quad Studio comes from the Quad software that turns a PC into a four-track real (not virtual) digital audio recorder. It's difficult to imagine how Turtle Beach could have made the software easier to use and still packed so many features and controls into it. Using the software is highly intuitive, even if you've never used multi-track recording equipment before.

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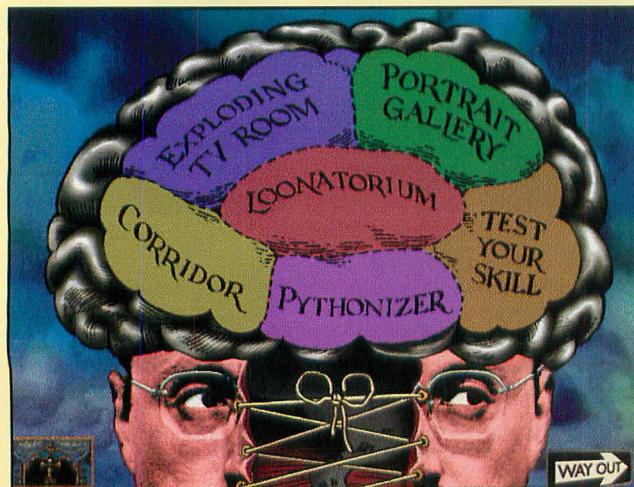


Try your skill at Spot The Loony or any of the other ridiculous games contained on the *Monty Python's Complete Waste of Time* CD-ROM. A Desktop Pythonizer application provides more than 20 interactive animated screen savers and much more.

One of the really outstanding capabilities of the software is Turtle Recall, a facility for "remembering" and automating the mixer sliders for each track. In a professional recording studio, most mixing boards can automate the sliders for each individual track, which effectively gives the technician or recording engineer lots of extra sets of hands to control all the faders. Since each track can have different volume settings throughout a musical score, it's impossible for a person to remember each setting for each track as the piece plays back.

Turtle Recall basically automates the mixing process by remembering how you move the output volume sliders for each track and automatically moving the sliders the same way during mix-down. This feature was really a bit of Nirvana for me because it let me do incredibly tight mixes that I wouldn't have thought possible without a professional mixing board in a recording studio.

Another nifty feature of the software is its ability to offset



Navigating to different sections of the program is done by clicking on different parts of the brain, shown above. For example, going into the portrait gallery treats you to some of the more-memorable sketches from the original BBC TV series, such as "The Dirty Vicar Sketch," "Nudge, Nudge," "The Argument Clinic," "Spam" and other timeless bits and pieces of often times bawdy and rude satire—in other words, the very stuff Python fans love.

playback times for each of the four recorded tracks—a particularly handy feature for doing multimedia work into which you might want to introduce sound effects, laughter or applause at certain points during a presentation.

The offset capability lets you cue incidental or additional sound elements with pristine precision and absolute synchronization, offering a time resolution of 0.001 second. The best way to illustrate how easy it is to work with Quad Studio is through an example:

(1) Choose some background music and record it on two tracks for stereo output, just as you would with a traditional tape recorder.

(2) While playing back and listening to the material just recorded, record a third track, such as a voice-over, guitar lead or singing.

(3) Play back the three tracks and add a fourth track—some background vocals, sound effects or whatever. Bear in mind that you can hear the previously recorded three tracks while you're recording this fourth part.

(4) Now set up playback. Let's say you want the music level to fade as your voice comes up. Here's where Turtle Recall really shines. With Turtle Recall recording moves in real-time and repeating them every time you play, you can mix and re-mix to your heart's content until you get it the way you want it.

(5) Finally, click on "mix" to create the finished two-track or stereo .WAV file. This frees up an additional two tracks for recording additional material.

The beauty of all this is that, unlike the case with tape, you're working with digital data here. Hence, you don't lose fidelity or experience signal degradation. You can keep adding parts on the two free tracks, doing another mix-down, adding more and mixing down as much as you want. The sky's the limit.

Another plus, especially if you intend to produce an audio CD of your material (as I'll be doing), is that when the mix-downs are completed, the final result is a stereo .WAV file that's exactly the format required to convert to audio CD (Redbook) format.

For MIDI users, the Tahiti card has a built-in MIDI interface. The Quad software provides plenty of control and options for using MIDI in the overall recording and mixing setup.

Synchronization of MIDI devices is also handled by the software, using the Tahiti card's capabilities. SMPTE (Society of Motion Picture and Television Engineers) time-code compliance is supported. So anyone who's doing serious multi-media A/V work will find Quad Studio to be fully capable of handling even the most-ambitious professional applications as well.

Also included with Quad Studio is Wave SE (Sound Editor). This isn't some stripped-down, rudimentary editor. Rather, it's a high-level, fully-capable editing and effects application that rivals (and in many cases exceeds) the features and capabilities of stand-alone sound-editing software packages that cost well in excess of \$100.

Wave SE provides all of the basic features you'd expect, such as cut, copy, paste, trim and markers for start and end. However, it goes way beyond the basics by providing a wealth of sonic tailoring tools for adding effects and sculpting the sound—even such extraordinary capabilities as time compression and expansion without altering pitch!

As a recording musician and the author of *Welcome To...PC Sound, Music and MIDI*, I've seen and worked with scores of different sound cards and PC audio software packages, so I'm not easily impressed. Turtle Beach's Quad Studio exceeded my expectations by a wide margin and totally wowed me. If you want to get into digital recording but thought you couldn't afford it, Quad Studio will get you into high-quality, high-capability digital sound without breaking the bank. With all the money you save you'll be able to get yourself a larger-capacity hard drive to give you extra recording time.

## Shoot Video Like A Pro

Lots of people own camcorders these days, and the manufacturers have done all they can to make using them as goof-proof as possible. So practically anyone who can point and shoot can produce acceptable-quality home videos. However, there's a big difference between acceptable quality and video that grabs and holds the attention of the viewer.

While researching material for my third book, *Introduction to Desktop Video* (which I'm currently writing), I came across a marvelous CD-ROM from Zelos titled *Shoot Video Like a Pro*.

This disc is a hybrid CD-ROM that runs on any MPC-2 PC or Macintosh. It segregates video production into its four integral key areas: camera, composition, lighting and audio.

In addition to providing an extensive glossary of terms used in video/cinematography production, the concepts and techniques introduced are fully explained through narration, on-screen text windows and extensive use of actual full-motion video footage. Clicking on a "trade secrets" button, included in each of the four sections, produces a video segment that gives some real "insider" information. Pros share their secrets and give advice on how they handle unusual situations while they're on a "shoot."

*Shoot Video Like A Pro* uses an interactive approach to convey the concepts and techniques that help improve home video productions. This is a terrific way to go because you learn by doing without leaving your PC to do so. The program's interactive nature lets you change variables in a scene and immediately see how they affect it. The interactive approach is a great way to see how lighting can change the ambiance, color and mood of a scene; how different compositional techniques can be used; how to get the best sound and more.

Even if you're a veteran camcorder user, I'm sure you'll find plenty of useful information, tips and tricks that help you to improve your videography with this CD-ROM. It's one of the best interactive tutorials I've come across to date, and I highly recommend it.

## Monty Python's Complete Waste of Time

The words "And now for something completely different..." can mean only one thing to any dyed-in-the-wool Pythonian—it's *Monty Python's Flying Circus* and it's here on CD-ROM, just in time to celebrate the zany group's 25th anniversary. Going under the moniker of *Monty Python's Complete Waste of Time*, it's a cornucopia of absurdity that I guarantee will both entertain you and substantially decrease your productivity on any PC on which you run it.

In the words of Terry Gilliam, one of the original *Monty Python* crew, "It's one of those annoyingly silly things that you can spend hours on to work out. And when you finally discover what it's all about, you realize you've wasted a great chunk of your life and can never get it back." While all of that is very true, Terry neglected to mention that you'll laugh hysterically along the way.

While including the best of the original BBS-TV series, there's a load of entirely new comedy and animation created especially for this insidious product by the same depraved minds who brought you the original shows. Among the unforgettable highlights from the original shows included are The Dead Parrot, The Cheese Shop, the Lumberjack Song, The Money Song and lots of other tasty (or should I say "tasteless") tidbits.

A Desktop Pythonizer utility makes it easy to create instant custom wallpaper from any scene with a Wallpaper Zapper, and you can squander precious time playing Living Wallpaper games while your computer continues to do productive work in the background. You can also harass and intimidate callers with pre-

## Products Mentioned

Quad Studio, \$499 with Tahiti Card; \$299 Quad software only  
**Turtle Beach Systems**

52 Grumbacher Rd.  
York, PA 17402  
Tel.: 800-645-5640

CIRCLE NO. 106 ON FREE INFORMATION CARD

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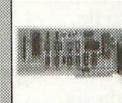
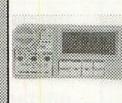
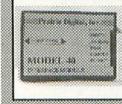
recorded telephone messages featuring a range of antisocial and silly comments. And, of course, there's a rich assortment of hilarious sound bites, bodily noises and enough other tidbits to keep even the sickest mind busy for a long, long time.

7th Level has managed to pack an amazing amount of lunacy on this single CD-ROM. In so doing, it has produced a masterpiece of recreational software. Get yourself a copy of *Monty Python's Complete Waste of Time* today and let the laughter begin!

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By Ted Needleman

## Microcomputer Musings

### Lots of Short Takes

**Sometimes, I feel like** the old Greek legend of Sisyphus. If you're not up on your mythology, he was the gentleman who had to push a stone up a mountain. Every night, when he fell asleep, the stone slipped back down, canceling out most of his progress. It's from this legend we get the expression "three steps forward, two steps back." With the stuff for review coming in at a much greater rate than I can write about it, I frequently feel that I know exactly how Sisyphus felt.

In a valiant effort to tell you about some of the neat stuff that's been sent to me in recent months, in the next few columns I'll try to cover more products, perhaps in just a bit less detail than I usually do.

#### Diamond Multimedia Kit

In recent years, Diamond Multimedia has become a familiar name in the personal-computing world. Starting out with a very successful line of video cards, the company has branched out into other audio/visual areas. With the introduction of its own line of sound cards a while back, Diamond even changed its name, adding the "Multimedia" appellation.

The stand-alone market for sound cards, though, didn't prove nearly as easy to break into as was the video-card market. This was especially true for a product line that's pretty much based on the Yamaha OPL-3 FM synthesis chip, considering that more and more users were going the wave-table sound-card route.

Diamond was quick to realize this and turned its efforts toward offering complete multimedia upgrade kits. The Model 5000 I received for review is pretty much the company's top-of-the-line kit, though Diamond is in the process of introducing a number of additional models that should be available by the time this review sees print.

The Model 5000 is an everything-but-the-kitchen-sink approach based around a quad-speed CD-ROM drive and Diamond's own 16-bit sound card. The sound card is OPL-3 based. As such, it offers the standard 20 voices and 44-kHz sampling rate that have come to be expected of this technology. Connectors on the card allow you to upgrade to wave-table synthesis, either with Diamond's own upgrade or any other Wave Blaster-compatible daughterboard.

The sound card also serves as the controller for the CD-ROM drive. The drive in the kit I examined was a Teac unit. Diamond informs me that it's switching over to a Mitsumi drive. Both are caddie-less designs and should offer equivalent performance.

In line with giving everything

you need, Diamond also provides speakers, earphones and a microphone. Both earphones and mike are pretty much run-of-the-mill generic models. The speakers are fairly decent units that can be used unpowered, can be run off the 2-watt-per-channel output of the sound card or be used with a set of AA cells in each unit or a 6-volt power supply (neither of which is included) when used in powered mode. Again, while the sound quality of these units isn't bad, it doesn't begin to approach that of a set of high-end speakers like the Yamaha speakers I discuss later in this column.

The last component of the package is software, of which Diamond gives plenty—30 titles, in fact. Unfortunately, ten of these are shareware, like *Doom* and *Wolfenstein*, which may be great games, but if you don't already have them, you're probably not all that interested. The next ten are a variety of *Interplay* titles. Same comment applies. There are the requisite encyclopedia (*Compton's*) and some very nice titles like *Myst*. How attractive or compelling a purchase reason you'll find any of these 30 titles to be depends largely on your taste in software and what you might already have.

It's quite possible that Diamond will change some of the titles I received in my review kit by the time this appears in print. Things occur really quick in this business, and who knows what kind of deals you'll be able to get in the couple of months it will take before you read this.

Aside from the above, Diamond has done a bang-up job making the multimedia kit a breeze to install. There's a great installation video that takes you through every step and a step-by-step photo "easel" to use while you're performing the installation.

The software installs pretty much automatically, and the hardware defaults worked just fine in my installation—which was a welcome change from what I usually go through when I install hardware.



Diamond Multimedia Systems' Speedstar Games Accelerator kit.

Diamond has gone to the "estimated street price" method pioneered by Microsoft last year. The company estimates the Model 5000's street price at about \$480. With the heavy competition in this market, there's a very real chance that the price could be way down near \$400 by the time you read this. So the bottom line is take a look and, if you like what you see, buy it.

## Putting on a Diamond Polish

While I'm on the subject of Diamond Multimedia, I also recently had a chance to test out one of the mainstays of the company's business, the SpeedStar video card. When I started to put together a new 486DX/50 for one of my kids, I looked to see what video cards I had available that would take advantage of the local-bus (VLB) video slot the motherboard offered.

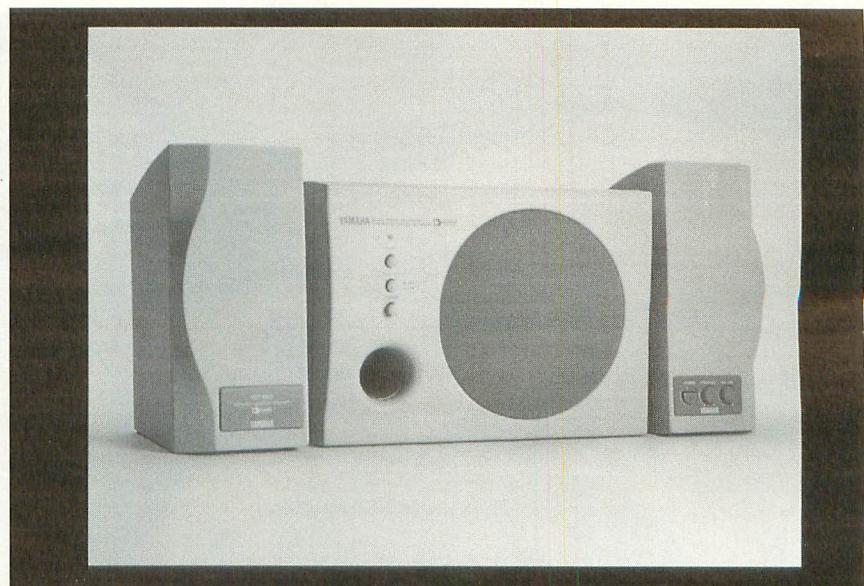
As luck would have it, in addition to the multimedia upgrade kit examined above, Diamond had also sent one of its SpeedStar Games Accelerator kits. This consists of the vendor's well-known SpeedStar video card and a set of 15 CD-ROM titles.

The SpeedStar card is available in VESA and PCI local-bus versions and a standard 16-bit ISA bus version for those of you who may not have a local-bus motherboard. It's a medium-performance card that uses a Cirrus Logic chipset and comes with 1M of DRAM video memory. Depending on your video monitor, the card can display at 1,280 x 1,024 in 16 colors, 640 x 480 in 16.7-million colors or several resolutions between these extremes.

The CD-ROM bundle has some similarities to the one included with the Model 5000 multimedia upgrade kit. Three of the titles are Accolade sports games and another 10 are the same Interplay 10-year Anthology that's in the upgrade kit. *Myst* and *Rebel Assault* round out the bundle.

Along with the CD-ROM bundle, you also get a copy of Diamond's *InControl Tools*. This terrific utility not only lets you control display functions, including color correction, it also lets you adjust many of the Windows Control Panel functions through an easy-to-use interface. *InControl* even adds features like adjustable cursor size and color. And Diamond's documentation, like the one that comes with the multimedia kit, is absolutely top-notch.

The SpeedStar is Diamond's least-expensive video card. As you go up in the line, through the Stealth and Viper models, you get added capabilities, features and price. I have to admit that, for my needs, the SpeedStar class of video cards seems to be just fine.



Yamaha's YST-SS1000 speaker system.

The VLB model I reviewed here has a list price of \$199 and \$129 with and without the CD-ROM package, respectively. To be honest, I think the "without" is a better value. With a street price of somewhere around a hundred bucks, the SpeedStar is a good choice for most video users. Its 72-Hz refresh rate makes it a good choice for upgrading to the 640 x 480 x 256-color SVGA most CD-ROMs require today.

## Gizzard-Grabbing Bass

I have to admit to being partial to my Yamaha YST-M10 speakers. I've had them for about a year and a half, and though you can certainly buy a set of more-expensive computer speakers (Altec will sell you some, as will Bose), I've been very impressed and happy with the excellent quality of sound I get from mine. At about \$80, while they're a lot more expensive than the type of speakers you get with most multimedia upgrade kits, they sound a whole lot better, too. In fact, I've been very quick to recommend them to anyone who asks.

Time moves on, though, and with it comes change. Recently, I received a new set of speakers that have displaced the YST-M10s in my affections. I don't think the folks at Yamaha will be too upset, though, because the new object of my attention is the company's latest, the YST-SS1010. This is a set of YST-M10s coupled with the new MSW10 subwoofer.

I'm not really all that much of an audiophile, and I've never paid much attention to subwoofers, even though the first thing I do with a new stereo is crank up the bass. Boy, have I been missing something.

The YST-MSW10 subwoofer is a com-

pact 12" wide x 9" high x 9" deep unit with its own on-board 25-watt amplifier and ac power supply. It plugs into the line-output jack on your sound card, and you plug the YST-M10 speakers into the subwoofer. That's it, except for adjusting volume and high-cut controls.

My subwoofer is located on the floor under my computer desk, where it's a bit difficult to get to the power switch to turn it on and off. This is okay. I just leave it on. It turns itself off when 5 minutes go by without an audio signal, and it comes right back on when it senses a signal coming in.

You can buy the subwoofer separately, at a list price of \$179, but you should be able to find it for substantially less. Alternatively, you can purchase it in a bundle with Yamaha's fantastic 10-watt-per-channel YST-M10s or the new 5-watt-per-channel YST-M5s. Any way you go, however, you're sure to really like the sound.

If you've never experienced just how much a subwoofer adds to multimedia, games and even "just" music, do yourself a favor and run over to the store and give a listen. I'm just sorry I didn't find this out until recently.

## Pick a Disc, Any Disc

Okay, I admit it. I hate shuffling discs. I hated doing it when the disks were the floppy kind, which is why I went for the expense of a hard disk the first time all those years ago. Now that so much of my software comes on (and runs off) CD-ROM discs, I'm starting to get tired of swapping those little silver platters in and out of my drive. So the arrival of the carton containing Mountain Network Computer's CD-7 was fortuitous.



Mountain Network Solutions' CD-7 double-speed CD-ROM changer.

The CD-7 is an external unit that isn't much larger than a typical external CD-ROM drive and holds seven discs. Unlike the magazine unit on Pioneer's changers, the CD-7 loads through a familiar slide-out tray. By pressing one of seven small buttons that stretch across the top of the unit, you tell the drive in which position to store the disc.

The driver that comes with the CD-7 right now assigns a different drive letter to each of the seven discs. A new utility, called CD PATHfinder (which I tested in

beta form), creates a virtual CD-ROM drive and assigns subdirectories for each of the seven discs.

Because the CD-7 is a SCSI unit, installing it can go either smoothly or, as in my case, roughly. Rather than bore you with the details (none of which are Mountain's fault) I'll just caution you to check with the peripheral vendor to see which SCSI interface cards it recommends for use with the unit. If things don't work, remember to check for address and IRQ conflicts first!

At a list price of \$599 and a street price less than \$500, the CD-7 is pricey for a double-speed unit. But it most definitely is convenient to be able to leave my frequently used CD-ROMs on-line. At most, it takes a bit shorter than 10 seconds for the unit to unload the last-referenced disc and load the one you need. This is an easy feature to get used to!

## Best of Both Worlds

Sometimes, I find it difficult to remember how I ever managed before I had a fax machine in my home office. Like many of you, I commute to my "real" job, in midtown Manhattan. This office is 42 miles from my house in the suburbs and almost an hour's commute at the best of times. In bad weather, or if there's an accident along the way, the drive can stretch out considerably.

Last winter, with the 17 major storms we had here in the East, there were several days when it took four hours to go those 42 miles. Needless to say, I try to work in my home office whenever possible. But since an important part of my job has me examining document proofs, fax has provided the essential ability to mark up a document and return a proof to the person in the office who needed to deal with my comments.

Over the years, I've bounced back and forth between PC-based fax cards, stand-alone fax machines and even a flatbed scanner. The scanner offered the most versatility, in that I could use it for things other than faxing documents. But it was really awkward using it for fax when I had more than a page to send.

The latest addition to my home office, Plustek's ScanFX, is the best solution I've come across yet. Basically, it's a 24-bit color scanner. Rather than placing a page on an unmoving platen, as you would with an HP ScanJet, you feed the page into the top of the ScanFX unit the same way you would with a fax machine. The input hopper can hold up to 10 pages of letter- or legal-size paper, which move page by page over the scan head. The paper moves right along (Plustek claims 4.5 pages per minute), and the unit offers an optical resolution of 300 x 600 dpi.

Somewhat surprisingly for a unit that moves the paper, rather than a scan head (which can be moved with much greater precision), the scanner offers excellent quality scans. The unit ships with a TWAIN driver (which allows it to be accessed from any Windows application that supports the TWAIN standard—and most do), and Micrografx's *Picture Publisher LE* editing software. There's also a copy of Calera's *WordScan 3.0* OCR package. Both of these applications are good qual-



Plustek's 24-bit color scanner/fax system/copier.

ty, though just a little less feature-rich than the top-of-the-line packages.

What really sets ScanFX apart, though, is how easy it is to use for most of its functions. About the same size as a small stand-alone fax machine, the ScanFX unit needs to use the fax card and printer installed in your PC. With these installed, the process of sending a fax is just about the same as for sending one from a stand-alone fax machine. Put the document you want to send into the unit, enter the telephone number on the unit's keypad (or use one of the user-programmable buttons) and press the big FAX button.

If you already know how to send a fax, there's no learning curve with ScanFX. Because the fax modem is PC-based, you also get the advantages of PC fax—large numbers of disk-based telephone books, fax broadcast and, if your fax software (not included with ScanFX) offers it, custom cover pages. And ScanFX gives you something no PC-based fax machine can—a COPY button that scans in your document and prints it out on your printer. If you have a color printer, like the Epson Color Stylus hooked up on mine, you can scan a color original and print a color copy!

If your receiver has the appropriate software, you can even fax it in color. And

if it doesn't ScanFX comes with a color fax utility that you're allowed to distribute to your associates at no charge.

ScanFX comes with an interface card that must be installed in your PC. This took me about 15 minutes to accomplish because the default IRQ to which the scanner's card was set was in use on my PC. When the card is installed, it also supplies power to the scanner unit, eliminating the

need for another ac power cord.

ScanFX isn't cheap at an SRP of \$799, but you may be able to find it for \$650 or so. The price isn't all that excessive. It's less than you'll pay for a top-quality fax machine and about what a decent 24-bit color scanner alone goes for. Factor in that the ScanFX offers more than either device, the this product gets my very definite recommendation! ■

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ScanFX, \$799 (SRP)

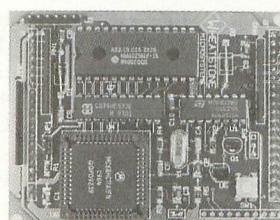
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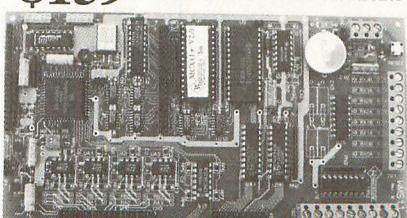


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By Joe Desposito

## Computing on the Go

# Add-Ons to Enhance Portable Computing

**When I switched** from using a monochrome Epson ActionNote 4000 to Toshiba's Protégé T3400CT active-matrix color subnotebook computer, I gained a beautiful display, but I lost something, too. With the 4000, I was able to attach an external mouse, keyboard and display. With the T3400CT, I can attach a mouse and display but not a keyboard, unless I spend another \$250 for a port-replicator device.

The keyboard on the T3400CT is fine for occasional use and short stints at it, but for long stretches of typing, I prefer a standard keyboard. This is why I became interested in the Alps LPT-101 keyboard.

As its name subtly suggests, the LPT-101 keyboard connects to the parallel port of a computer. This is perfect for a portable like the T3400CT. To install the keyboard, you simply plug it into the parallel port. A pass-through connector ensures that you don't have to sacrifice printing from your notebook PC. You also have to install software for DOS and *Windows*.

After installing the software, I re-booted the T3400CT and tried out the keyboard. It worked very well in *Windows*, where there was no discernible difference between this parallel-port version and a standard keyboard. However, in DOS, I found one problem with the DOS Editor.

When I hit an Alt-key combination, the keyboard stopped working. I didn't try the keyboard with any other DOS programs, since I don't have any loaded on the T3400CT.

Software utilities supplied with the LPT-101 let you do a few different things with the keyboard. For example, you can turn it on and off if you notice any compatibility problems with a particular application. You might want to do this before using the DOS Editor, for example.

The Alps LPT-101 is a standard 101-key keyboard that has a separate numeric keypad. The keyboard works with any AT- or XT-type computer, not just portables, which is good to know if you ever have a sudden keyboard failure on your desktop PC.

At a suggested list price of \$109, the Alps LPT-101 offers a good alternative to purchasing a more-expensive port replicator or docking station if all you desire is full-size keyboard capability for your portable. However, if you use a particular DOS program extensively, you may want to check with the

company first to find out if the LPT-101 is compatible with that program.

## More Alps Products

Alps was kind enough to send along two more products for review. One was the GlidePoint pointing device, the other a parallel-port numeric keypad.

GlidePoint replaces a mouse or a trackball with a touch-sensitive pad that measures only 3" x 2 3/4" and has an active surface area of about 2" x 1 1/2" and weighs just 2 oz., including a 2.5-foot cable. Three buttons are on its face, two at the base of the

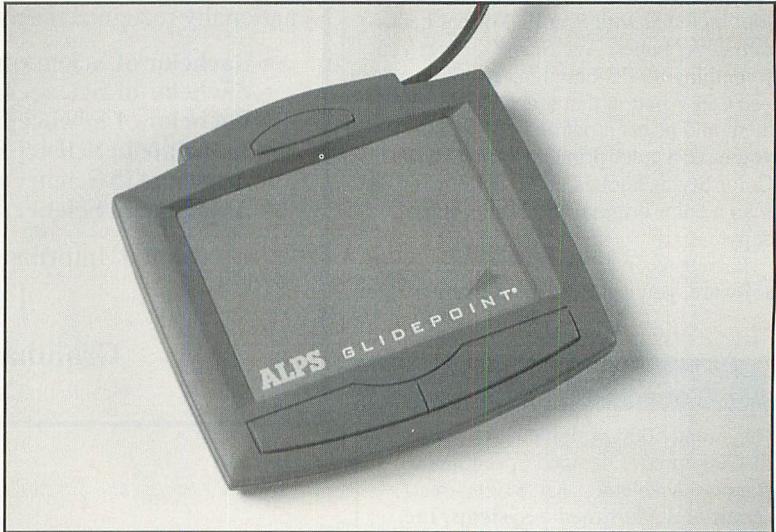


Fig. 1. The Alps GlidePoint.

active surface and one at the top (Fig. 1). A 4-foot extension cable is also included in the package.

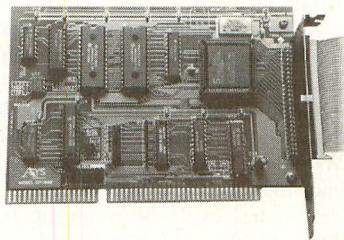
I realized right away that GlidePoint wouldn't work with the T3400CT because the one I received is a PS/2 mouse port version, while the T3400CT doesn't have a PS/2 port. However, since the ActionNote 4000 does have a PS/2 port, I used the 4000 to test GlidePoint. (A serial port version of GlidePoint is also available.)

GlidePoint works right out of the box, as soon as you plug it in. Since it's compatible with the Microsoft soft Mouse, no software installation is required. Technically, GlidePoint works through a technique called field distortion sensing, which is a form of capacitance-sensing technology. Under GlidePoint's sealed surface are two layers of fine electrical conductors that are arranged in a grid pattern, as shown in Fig. 2. This grid creates an electrical field over the surface.

When you touch GlidePoint's surface, your fingertip (not a pen or other mechanical pointer) distorts the electrical field at that point. By scanning

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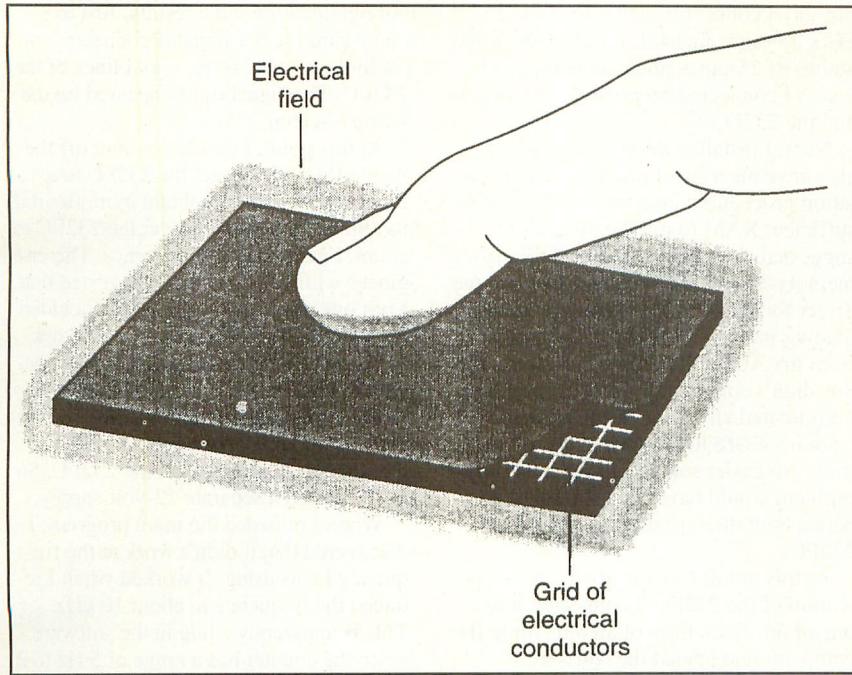


Fig. 2. The GlidePoint uses field distortion detection to sense the position of your finger on its touchpad.

the grid and sensing the strength of the distortion on each conductor, GlidePoint can precisely locate where your fingertip touches.

As you move your fingertip across the pad, GlidePoint tracks its motion by following the changes in the electric field. With a resolution of 400 points per inch, GlidePoint can detect even very small movements. Since the surface isn't pressure sensitive, a light touch is sufficient for GlidePoint to determine the location or movement.

When I first tried to use GlidePoint, clicking on the buttons seemed a bit awkward. However, you don't have to click on the buttons if you don't want to. Instead, you can tap on the touch-sensitive pad. One tap signals a single click, two taps signal a double-click and two taps plus a slide allows you to drag. All of this worked very well.

Alps includes software that lets you take full advantage of GlidePoint. The software lets you adjust pointer, motion, orientation and shortcut settings. These are helpful to adjust, for example, pointer trails, acceleration, sensitivity, etc.

If you aren't happy with your mouse, trackball or other pointing device, you should give GlidePoint serious consideration. GlidePoint offers an excellent alternative to traditional pointing devices.

The final Alps product is the full-size KPX-17P keypad that plugs into the parallel port of a portable computer. Though I wouldn't have much use for the KPX-17P, accountants, salespeople and others

who crunch numbers all the time will welcome this device.

The KPX-17 installs in the same manner as the Alps keyboard described above does. Once you finish installing the software and re-boot your computer, you can start using the keypad. When I punched the keys as fast as I could, the numbers appeared on-screen without a delay. I used the keypad with the *Windows* calculator and with Microsoft *Excel* without experiencing any problems.

The KPX-17P keypad carries a suggested list price of \$95. A KPX-17S serial-port version of the keypad sells for the same price. If you need this kind of functionality for your portable, the KPX-17 or KPX-17/S is a worthwhile buy.

### Counting Frequency

Being that I'm always interested in new uses for my portable computer, I'm also always on the lookout for computer-based electronic instruments. So it was with great interest that I contacted B&B Electronics about its new Model 232FC RS-232 Frequency Counter.

The 232FC looks like a null modem with a small section of printed-circuit board projecting out one side of its case. On the board is a four-position connector block labeled SIGNAL, GND, +12V and GND. Also contained in the package are a utility disk and a 12-page Instruction Manual. Obviously, the device's circuitry resides inside the small case.

The RS232FC lets you make frequency

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measurements of TTL and CMOS level signals through any RS-232 port, which means the device can be used with desktops as well as portable PCs. It can be powered from the port's handshake lines or an external 12-volt dc external supply. Software included with the device lets you do data sampling and then log and plot frequency and duty-cycle information and display histograms. Also included is sample code in BASIC, Pascal and C that demonstrate the 232FC commands.

With the 232FC, you can make frequency measurements from 5 Hz to 2 MHz and duty-cycle measurements from 25 Hz to 50 kHz. The 232FC uses a counter to measure the pulse width of the input signal. The counter checks the state of the input signal approximately once every 1.3  $\mu$ s. Be aware that with this type of fixed-resolution measurement, error increases with input frequency.

To extend the maximum frequency range and decrease measurement error, the 232FC uses direct and prescale modes of operation. Direct mode uses the 1.3- $\mu$ s resolution to make frequency and duty-cycle measurements at frequencies from 5 Hz to 50 kHz. Prescale mode divides the input signal by a programmable divisor from 2 through 256 to greatly extend the frequency range. However, using prescale mode locks out the capability of making duty-cycle measurements. In prescale mode, measurements can be made from 25 Hz to 2 MHz.

When I attempted to connect the 232FC to the Toshiba T3400CT, I immediately encountered a problem. As is the case with most other portables and many desktop PCs, the T3400CT uses a nine-

pin serial connector, rather than the 232FC's 25-pin connector. Fortunately, I had a nine-to-25-pin adapter cable on hand, which I connected between the T3400CT and the 232FC.

Next, I installed the software, which also gave me a small problem. The installation procedure noted that I didn't have sufficient RAM to run the program. It suggested that I remove some TSRs from memory. I remembered that I still had the driver for the Alps keypad automatically loading into RAM. So I removed this from my AUTOEXEC.BAT file. Being that this didn't completely solve the problem, I eliminated all of my PCMCIA drivers from my CONFIG.SYS file. This did the trick. An easier solution to the memory problem would have been for me to prepare a boot disk specifically for the 232FC.

At this point, I was ready to check operation of the 232FC. I connected it to one of the clock lines of an old Apple II+ computer and loaded the software.

The software is a menu-based DOS program that offers 16 choices, which break down into data-acquisition, plotting and analysis. I selected the Record Data option and waited for the results. Unfortunately, the software returned a message indicating that it found no data. I rechecked the manual. Step two says to power the 232FC, either with an external 12-volt supply or by raising both the RTS and DTR handshake lines. I assumed the software was raising the RTS and DTR lines, but I couldn't tell for certain.

I ran a wire from the 12-volt line of the Apple II+ bus to make sure that the 232FC was powered. I ran the software again

but obtained the same results. Just to make sure I had a signal, I connected an oscilloscope across the signal lines of the 232FC. The signal trace appeared on the scope's screen.

At this point, I decided to shut off the Apple II+ and connect the 232FC to a function generator to obtain more flexibility. Since I still couldn't get the 232FC to count, I called B&B Electronics. The engineer with whom I spoke suggested that I run one of the demo programs included with the 232FC. When this didn't work, he suggested I raise the amplitude of the signal. Finally, the counter started to work. It read the frequency of the square wave at about 93 kHz. I also found out that the serial port powers the 232FC. So I didn't need a separate 12-volt supply.

When I reloaded the main program, I discovered that it didn't work at the frequency I was using. It worked when I reduced the frequency to about 10 kHz. This is apparently a bug in the software, since the counter has a range of 5 Hz to 2 MHz. The engineer told me that most people would write their own software interfaces, which is why B&B supplies the demo code.

I asked the engineer who might make use of this type of device. One use, he said, is as event counter for a mechanical device, such as a shaft encoder. Then I asked if the 232FC could be used as an intermittent event counter. The answer is no. Right now, the device doesn't have software support for this.

If you're in the market for a frequency counter in the 5-Hz-to-2-MHz frequency range for portable or desktop applications, the \$69.95 232FC is ideal for the job. However, if you aren't a programmer, you should check it to find out whether the included software will work properly for your application.

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## Products Mentioned

Alps LPT-101 Parallel Port Keyboard, \$109; Alps GlidePoint, \$96; Alps KXP-17P Parallel Port Numeric Keypad, \$95

### Alps Electric, Inc.

3553 N. First St.  
San Jose, CA 95134  
Tel.: 408-432-6000; fax: 408-432-6035

CIRCLE NO. 226 ON FREE INFORMATION CARD

Model 232FC RS-232 Frequency Counter, \$69.95

### B&B Electronics

707 Dayton Rd.  
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Ottawa, IL 61350  
Tel.: 815-434-0846; fax: 815-434-7094

CIRCLE NO. 227 ON FREE INFORMATION CARD

# The AmCoEx Index of Used-Computer Prices

**The flaw in Intel's Pentium chip** has caused a great deal of concern in the computer industry. No other company is more concerned than Microsoft. Flawed operations and miscalculations are rare in computer hardware but quite commonplace in software. Faced with releasing the most-ambitious new software product in history, flaws are inevitable in the next version of the *Windows* operating system. Intel has been strong-armed into a complete replacement policy for flawed chips.

If the computer-user community demands the same type of replacement policy from Microsoft, the new system may be far less profitable than previous versions. To fix the problems in *Windows 3.0*, Microsoft was able to sell *Windows 3.1* for a substantial profit. Given the current mood in the industry, it's unlikely Microsoft would get away with this. Users today would demand a free, and costly, replacement. With 60-million users, small problems will be costly and large problems will be devastating. This may explain why Microsoft has recently announced a delay in introducing the next version of *Windows* to allow for more testing. The company had stated that the product would be available in April. It now appears the product won't be available before August. The previously announced name for the product is *Windows 95*. Some people have joked the name should be changed to *Windows 95½*. Any further delay may warrant a name change to *Windows 96*.

A few years ago, Apple Computer sued Microsoft, claiming that Microsoft's *Windows* operating system infringed on its patents, copyrights, trademarks, good ideas, etc., utilized in the Macintosh operating system. Apple lost the lawsuit, and *Windows* continues to become more Mac-like. During this brouhaha, Apple's critics suggested that it was guilty of "innovation through litigation" and urged the company to beat Microsoft in the marketplace, not the courts. Critics of Microsoft continue to accuse it of "innovation through duplication," claiming that the idea behind every successful Microsoft product originated at some other company. These critics fear that when these smaller companies can no longer compete and cease to exist, so will most innovation in this industry.

These accusations may soon be renewed, following a recent lawsuit filed by Apple. In 1992, Apple hired the Canyon Co. to develop video software called *QuickTime for Windows*. Canyon later developed similar software for Intel's DCI (Display Control Interface), the DCI code of which is utilized in Microsoft's *Video for Windows*. Apple claims that some of its code is included in the Intel and Microsoft software. If Apple wins this lawsuit against Canyon, much of the multimedia code in the new version of *Windows* may be replaced, which could extend the delay of *Windows 95*.

Most software companies rely upon one main product for the majority of their profits. In an effort to break into new markets, they subsidize new efforts with profits from the main software product. Many times, they "buy" market share with prices far lower than the current market leaders'. This puts enormous pressure on the market leader when it matches price cuts, for this may be its principal

source of revenue. Borland International cut the price on its *Quattro Pro* spreadsheet to gain market share from Lotus' *1-2-3*. Since *1-2-3* was Lotus' principal source of revenue, the strategy was especially damaging to Lotus. Borland relied upon revenues from its database products to support this effort.

Then Microsoft used the same tactic against Borland. It took market share away from Borland by selling its database products at prices far lower than Borland had previously. This has had a devastating effect on Borland. Microsoft supported this effort with the enormous profits it reaps from sales of its operating-system software, MS-DOS and *Windows*. Microsoft has used its profits to support development or purchase of software in numerous other markets, like word-processing, spreadsheet and presentation software.

Apparently, IBM now plans to use the same strategy against Microsoft's dominance in operating-system software. While 15 times larger than Microsoft, IBM can subsidize its new OS/2 *Warp* to take market share away from Microsoft. IBM is undercutting Microsoft's price to computer makers to pre-load OS/2 on new computers instead of *Windows*.

In recent years, most of the value of used computers can be attributed to their hard drives and RAM memory. While RAM prices have held their value quite well, prices of hard drive have fallen rapidly. Small hard drives, of less than less than 100M capacity, have very little value. This is partly due to inexpensive large-capacity drives, but it's also due to the expansion in size of most software. For example, the MS-DOS operating system consumed only 5M of hard-drive capacity. The current version of *Windows* normally occupies 20M. *Windows 95*, may require more than 60M of storage space on a hard drive. In addition, applications are becoming larger. Microsoft's *Office*, a suite of several applications, can occupy more than 80M—and 95M and more for full installation—of drive space. These trends depress the values of older computers, since many have inadequate hard-drive capacity to handle the newer software.

New Macintosh computers will run software faster next year, the result of several factors. Apple was expected to have announced several new models of Power Macs by the time you read this. These computers will be 30% to 50% faster than their predecessors. In addition, Apple will improve the performance of the emulation software in its operating system. This is the software that permits the new Macs to run older software. Performance improvements are expected to yield between 50% and 100% faster operation. Apple may also offer a new DOS-compatible card for Quadras and Power Macs. The new card will use a 66-MHz 486 CPU chip for running *Windows* software.

## More News

Apple Computer is in a dilemma. It can't manufacture enough computers to meet the demand for its PowerPC Macintosh. While selling more computers and generating more profit than ever before, it still

has a shrinking percentage of the total computer marketplace. Since this percentage sways software developers, it isn't taken lightly. The solution should come as Apple licenses other computer companies to manufacture the Macintosh. Many industry analysts have suggested that Apple should have done this years ago. However, Apple is dependent upon its hardware revenue. It can't pull the rug out from under this portion of its profits and maintain itself on its software revenues. Licensing other vendors will foster competition, reduce prices and reduce profits in its hardware business.

Eventually, these Macintosh clones will generate more profits from licensing than they cost in lost hardware sales, but Apple can't afford to make the transition too quickly. Apparently, Apple's strategy is to start with smaller vendors. It has announced that Power Computers and Radius will soon offer Macintosh clones. Apple knows these manufacturers don't currently have the manufacturing capacity to cause a substantial effect on its profits initially.

As Apple makes the transition into a software company, clones manufactured by larger companies become a more realistic possibility. Companies like IBM, Motorola and Toshiba will likely be offering Macintosh clones in the near future, but only when Apple is comfortable with its new position in the industry.

For most microcomputer equipment, the Internal Revenue Service requires a five-year accounting life. This requirement is unrealistic in this fast-paced industry and causes enormous wasted resources. Thousands of companies are storing millions of unused computers until they can be out-placed without incurring a major financial loss. An example helps explain this. If a company purchases a new computer for \$5,000 and uses straight-line depreciation, after two years of use, the computer will have a value of \$3,000 on the company's books. However, it's unlikely the equipment will have a value this high in the used-equipment marketplace. A more-realistic figure might be \$1,000. If the company sells the computer for \$1,000, it must show a loss of \$2,000, as opposed to a depreciation expense of \$1,000 if the equipment is stored until next year. If this \$1,000 difference is multiplied by hundreds or thousands of computers, the additional losses amount to millions of dollars.

From a fiscal point of view, most companies would be better off to take the loss in one year, but from an accounting standpoint, other decisions may be made. This is especially true when the managers' bonuses and promotions are based upon this year's profitability. The solution will come when the IRS permits all computer equipment to be expensed in the year it's purchased or spread over two years at maximum. This equipment will no longer

## Prices For Used Computers as of January 6, 1995

Machine	Bid	Average Buyer's Ask	Average Seller's Close	Change(\$)
IBM PS/2 Model 70, 60M	\$350	\$600	\$425	-25
IBM PS/1 486DX2/50, 253M	900	1,350	1,000	-100
IBM PS/2 Model 90, 160M	1,000	1,500	1,125	-125
IBM ThinkPad 350C	1,900	2,400	2,100	-50
IBM ThinkPad 700	1,000	1,700	1,175	-75
IBM ThinkPad 720	1,600	2,000	1,650	-75
AST 486SX/25, 170M	700	1,250	825	-50
AST 486DX/66, 340M	1,050	1,650	1,00	+125
Dell 386/33, 100M	600	1,000	700	—
Dell 486DX/33, 240M	850	1,500	1,025	-75
Gateway 386/25, 80M	400	800	575	-50
Gateway 486/33, 120M	800	1,200	950	+25
Clone Notebook 386SX, 40 M	500	900	675	-50
Clone 386/33, 80M, VGA	450	900	575	-75
Clone 486/25, 120M, VGA	700	1,200	950	-25
Clone 486DX/33, 240M	800	1,425	1,050	-75
Compaq LTE 286, 40M	250	675	350	-50
Compaq Contura, 320 60M	500	1,000	900	—
Compaq Contura 4/25, 120M	1,100	1,600	1,075	-25
Compaq Deskpro 386/20e, 100M	500	800	575	-75
Compaq Deskpro 486/33, 120M	1,100	1,650	1,025	-75
Mac Classic II, 80M	400	800	525	-75
Mac IIci, 160M	500	900	575	-75
Macintosh IIcx, 80M	300	700	375	-25
Macintosh IIci, 80M	500	950	675	+75
Macintosh IIfx, 80M	700	1,250	850	-100
Mac Quadra 700, 230M	1,100	1,600	1,300	-100
Mac Quadra 800, 500M	2,000	2,700	2,250	-100
PowerBook 140, 40M	700	1,100	775	-75
PowerBook 170, 40M	800	1,350	1,125	+25
PowerBook 180, 80M	1,200	1,850	1,775	-50
LaserWriterPro 630	1,300	1,775	1,475	-75
Toshiba 1900, 120M	800	1,200	900	-50
Toshiba 3200 SXC, 120M	1,850	2,950	1,925	-125
Toshiba 3300SL, 120M	1,050	1,600	1,025	-75
Toshiba 5200, 100M	750	1,050	825	-50
HP LaserJet II	350	850	575	-50
HP LaserJet IIP	350	950	475	-25
HP LaserJet III	600	950	700	—
HP LaserJet IV	900	1,300	1,000	—

need to be stored. It can be put to good use in the used-equipment marketplace or even be exported to developing countries, improving our balance of trade.

Most software companies rely heavily upon revenues from product upgrades to fuel their growth. Some of these companies are currently accusing Microsoft of a conspiracy to cripple this growth while preparing to enter their markets. The conspiracy theory works like this. Microsoft evangelized the next version of *Windows*, now dubbed *Windows 95*, preaching that all smart software companies would be well-advised to plan the next version of their software for this forthcoming platform. Microsoft led them to believe that the new *Windows* would be available in 1994. Many software companies had their next versions ready to go to market then. But since Microsoft has delayed introduction of the new *Windows* until at least Au-

gust 1995, and maybe longer, many of these smaller software companies are now suffering. Some people think Microsoft will offer competing application and utility software when *Windows 95* finally makes it to market. However, by delaying the introduction of the new *Windows*, the smaller companies will be reduced to ineffective competitors.

It isn't likely that Bill Gates, CEO of Microsoft, would elect to delay the introduction of a product as important as *Windows 95* for these purposes. The fact that it could occur, some argue, is reason enough to force Microsoft to split into two companies. This would split operating-system software from its other ventures. Likening this to the breakup of "Ma Bell," some people are calling it the breakup of "Ma Bill."

The next-generation CPU chip from Intel, known as the P6, is expected to be

## Prices For Used Computers as of February 3, 1995

Machine	Average Buyer's Bid	Average Seller's Ask	Close	Change (\$)
IBM PS/2 Model 70, 60M	\$350	\$600	\$425	+25
IBM PS/1 486DX2/50, 253M	900	1,350	975	—
IBM PS/2 Model 90, 160M	1,000	1,500	1,100	—
IBM ThinkPad 350C	1,900	2,400	2,050	-50
IBM ThinkPad 700	1,000	1,700	1,100	-50
IBM ThinkPad 720	1,600	2,000	1,600	—
AST 486SX/25, 170M	700	1,250	875	—
AST 486DX/66, 340M	1,050	1,650	1,175	+25
Dell 386/33, 100M	600	1,000	700	—
Dell 486DX/33, 240M	850	1,500	1,000	-50
Gateway 386/25, 80M	400	800	550	—
Gateway 486/33, 120M	800	1,200	950	—
Clone Notebook 386SX, 40M	500	900	600	—
Clone 386/33, 80M, VGA	450	900	550	+50
Clone 486/25, 120M, VGA	700	1,200	1,000	+50
Clone 486DX/33, 240M	800	1,425	1,075	+25
Compaq LTE 286, 40M	250	675	300	—
Compaq Contura 320, 60M	500	1,000	875	—
Compaq Contura 4/25, 120M	900	1,400	1,050	+50
Compaq Deskpro 386/20e, 100M500	800	525	—	—
Compaq Deskpro 486/33, 120M	1,100	1,650	1,050	+25
Mac Classic II, 80M	400	800	475	—
Mac IIxi, 160M	500	900	650	+25
Macintosh IIcx, 80M	300	700	350	—
Macintosh IIci, 80M	500	950	700	—
Macintosh IIfx, 80M	700	1,250	850	—
Mac Quadra 700, 230M	1,100	1,600	1,250	-50
Mac Quadra 800, 500M	2,000	2,700	2,200	—
PowerBook 140, 40M	700	1,100	825	—
PowerBook 170, 40M	800	1,350	1,025	-50
PowerBook 180, 80M	1,200	1,850	1,725	—
LaserWriterPro 630	1,300	1,775	1,425	-25
Toshiba 1900, 120M	800	1,200	875	—
Toshiba 3200 SXC, 120M	1,850	2,950	1,950	+50
Toshiba 3300SL, 120M	1,050	1,600	1,000	—
Toshiba 5200, 100M	750	1,050	800	—
HP LaserJet II	350	850	525	-25
HP LaserJet IIP	350	950	475	—
HP LaserJet III	600	950	625	-50
HP LaserJet IV	900	1,300	1,000	—

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announced in June or July of this year. It will likely reach the marketplace close to the end of 1995. The first P6 chip is expected to run at 133 MHz. Its performance is expected to be approximately twice that of the 90-MHz Pentium. A faster 120-MHz Pentium chip should arrive on the market by the time you read this. These events, coupled with the loss of a lawsuit with Advanced Micro Devices, will cause Intel to dramatically lower prices for most of its existing products between now and May of this year. Some experts are predicting chip prices will drop by 50% between now and then. Lower prices on new and used computers should result. ■

While Apple's top of the line Macintosh currently outperforms the top Pentium, its next-generation PowerPC-based Macintosh is expected this summer. The PowerPC 604 chip is expected to be 60% faster than today's top model. Because the PowerPC chip yields greater performance at a lower cost, Apple has been able to charge more for its top performers while lowering its cost of production. This helped Apple achieve record profits for the last quarter. In addition, the expanding home market for computers has been a big boost to Apple. The company's Macintosh has always been more popular among individual users than in corporations. ■

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2 sq. in. proto area	\$134.95 w/cabinet
Requires 5V at 50mA	& cable
Terminal strip for easy connection	
<b>M2802</b> (not shown)	<b>\$99.95</b>
8 5A SPDT relays	
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Requires 5V at 800mA (all relays on)	

## 80C52-BASIC Microcontroller



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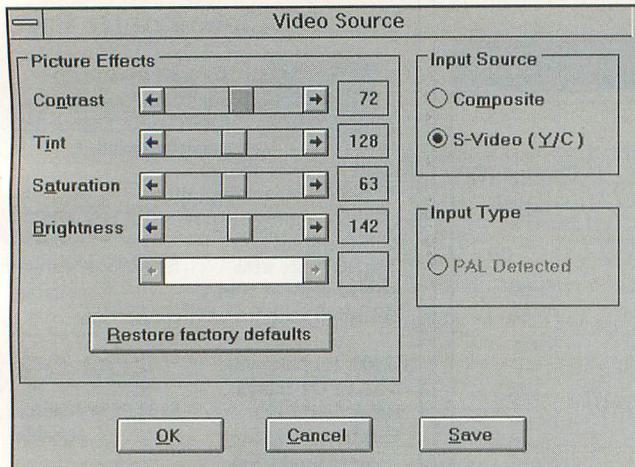
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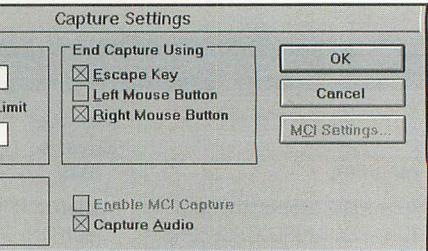


**Fig. 11.** Smart Video Recorder Pro accepts composite or S-Video input sources in NTSC or PAL formats. S-Video yields best picture quality for captures. Appearance of picture can also be adjusted from this screen, although defaults usually deliver best result in most cases.

ceptable color quality can be a challenge when you're working with eight-bit videos, which are commonly used in desktop presentations. If an eight-bit video file uses several different color palettes, the video goes through palette shifts when the video plays. You can avoid these and create smooth, professional videos by creating a palette that's optimized for the colors in your video. You can include the colors in the presentation in which your video will be played as part of this palette. You can then apply this optimized palette to your video and save it for use with other videos.

Although you typically create and apply palettes after importing and arranging media clips on the timeline, it's a good idea to plan for color before you start creating a video. In general, if your final video will be played back on an eight-bit monitor, you should limit color changes within the video, if possible, particularly if your video contains color video segments (as opposed to black-and-white videos or simpler animations, for example).

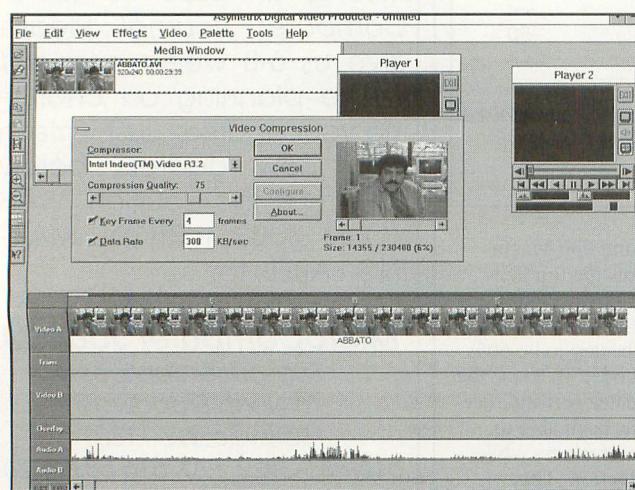
• **Preview the video.** It's a good idea to frequently check your progress as you create your video. You can do this in *DVP* without actually building a ver-



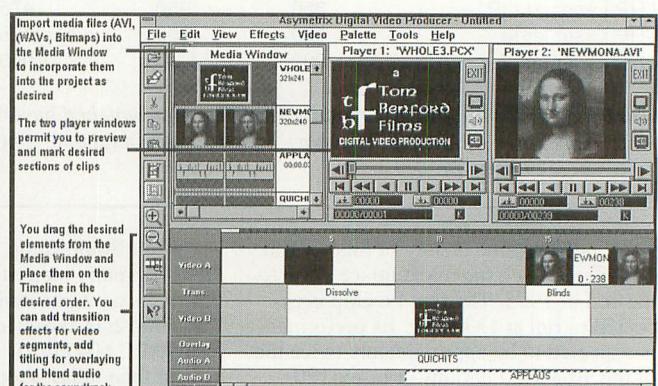
**Fig. 12.** Capture Settings screen lets you specify desired frame rate, whether to capture audio simultaneously and whether to capture directly to disk or memory. Copious amounts of RAM are required for memory captures of any duration, with 64M typically required for 1-minute capture at 30 fps in 320 x 240 mode using the R3.2 compressor. Raw captures require even more RAM.

sion of your video, which can be time-consuming, by previewing the contents of the timeline, including transitions, filters, titles, keying, audio and palettes you've applied.

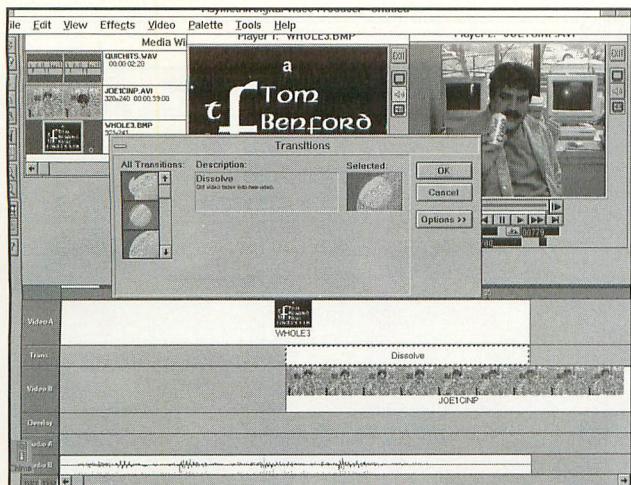
Note that previewing the contents of the timeline is different than previewing a single media file. You preview the contents of the timeline in the preview window. Because *DVP* must play each media clip and effect simultaneously, playback is slower than it is in the final video. In contrast, you preview (and mark) single video clips in a Player, where you can step through them frame by frame or play them in



**Fig. 13.** Video compression dialogue window is open here, with its preview window showing first frame of source file that has been dragged from *DVP* media window onto Video "A" section of timeline. Note corresponding audio soundtrack in Audio "A" section below it.



**Fig. 14.** Main screen of *Digital Video Producer* is where production elements are selected, previewed, marked and inserted into timeline in desired playback order. Toolbar at left side of screen uses "generic" icons, such as scissors for cut function, magnifying glasses with + and - symbols to control zoom view and other conventional symbols that will be familiar to most *Windows* users. Program interface is highly intuitive and exceptionally easy to learn, considering impressive effects and power it delivers.



**Fig. 15.** Dissolve effect was used in this example to make transition from Tom Benford Films logo into opening scene of Joe. An opening audio track (QUICHITS.WAV) was also added to accompany opening logo sequence. Transitions dialogue from Effects menu is visible, with dissolve effect currently selected.

real-time. Even though previewing the timeline contents isn't in real-time, you still get a good idea of how all the elements will work together.

• **Build the video.** When your video is arranged the way you want it on the *DVP* timeline, the challenge is to build an output video that meets both your technical and aesthetic requirements. At this stage, you need to decide how to handle the tradeoff between quality and economy. In general, the higher the quality of a video, the more expensive the hardware needed to play it properly. More particularly, you have to decide such issues as:

How many colors to use: eight-bit or better

What size and visual quality you require

How good must be the sound (does it only include a voice or music that requires higher-quality reproduction?)

How much information the playback equipment must be able to handle (in particular, will the video be played back from a CD-ROM, which is slower than a hard disk and, therefore, can't handle as much information?)

File size limitations for your video

Decisions about the foregoing and others come into play when you build a video. You control the quality and economy of your video by specifying the frame size and format of the video, quality of the audio, type of compression, data rate, key frames, bit depth and other important factors.

You also have other options you may wish to exercise. For example, you can build your video in other formats, such as a series of bitmaps or simply as an audio file. As you can see, you have a lot of creative freedom.

• **Save your project.** It's a good idea to save your project file often throughout the process of creating your video, as you do for any important work. Not only do you avoid losing work in the event that a system failure or other problem occurs, but you can use the current project as the basis for creating different versions of your video in the future.

## Pro Level Effects

One of the nicest features about *DVP* is the rich assortment of transition effects it provides to smoothly shift from one scene to another. When two video tracks overlap, *DVP* automatically adds the default transition, a wipe. You can modify the transition by replacing the wipe with anyone of these supplied transitional effects (Fig. 15):

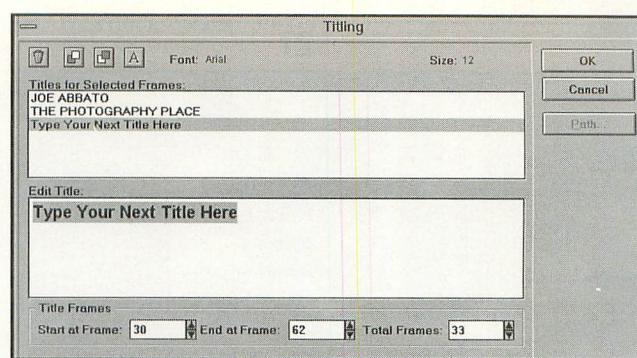
**Wipe**—new video gradually covers old video (selectable option)

**Dissolve**—old video fades into new video

**Iris**—old video opens up into new video (iris shape is a selectable option)

**Clock**—new video covers old video in circular motion

**Slide-In**—video slides on-screen, covering old video (slide-in direction is a selectable option)



**Fig. 16.** *DVP* gives lots of flexibility with regard to generating titles and placing them in video. You can overlay text over video scenes and specify title movement, such as rotation, spin or crawls.

**Slide-Out**—old video slides off-screen, revealing new video (slide-out direction is a selectable option)

**Band Slide-In**—bands of new video slide into view, covering old video (selectable options include vertical or horizontal bands and their number)

**Band Slide-Out**—old video splits into bands and slides off, revealing new video (as with the band slide-in, number and vertical or horizontal positioning of bands are selectable options)

**Barn Doors**—old video splits to reveal new video (orientation of the door slide is a selectable option)

**Blinds**—new video wipes over old video in several bands, similar to opening up Venetian blinds (vertical or horizontal orientation and number of blinds are selectable options)

**Push**—new video pushes old video off screen (push direction is a selectable option)

**Blocks**—blocks of new video appear, covering old video (size of grid and pattern of block removal are selectable options)

**Fizzle**—old video “fizzles” pixel by pixel into new video

**Blizzard**—old video “blows away,” revealing new video.

You can also easily generate titles using any *TrueType* font currently loaded in *Windows*. Titling dialogue is available from the effects menu, and you're given all of the usual options for style, size and font, as well as color and positioning of the text. The



**Fig. 17.** Result of dissolve transition specified in example project using the preview mode, 27 frames into video project. Logo is fading out while opening scene of Joe is fading in on top of it, resulting in what's known as lap dissolve in cinematography terms, since two scenes overlap and dissolve into each other.

Path button brings up an additional dialogue screen that lets you specify directional attributes if you want the text to move on the video. Rotations

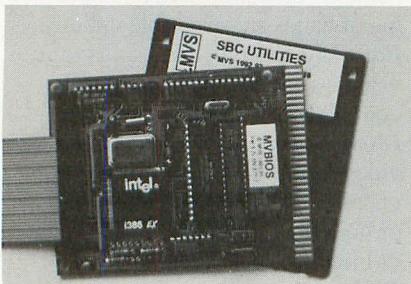
and crawls are included in the titling movement paths, and you can select the speed and duration for the titles to be visible (Fig. 16).

**JOE ABBATO**  
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**Fig. 18.** Text generated with titling utility is overlaid on running video footage, shown here using preview utility at frame 62 in project. Capability to add and overlay text, graphics and audio, in addition to transition effects for blending various video elements, gives plenty of latitude for even most ambitious project and creative imagination.

Without a doubt, the best way to learn how to use the *DVP* program is to perform some captures with Smart Video Recorder Pro and experiment

## 386 SBC \$83

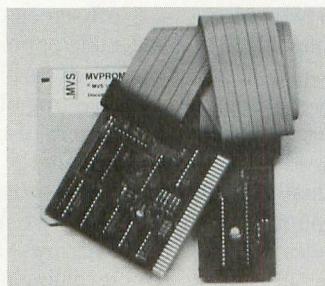


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## Products Mentioned

Intel Smart Video Recorder Pro, \$449.95

### Intel Corp.

5200 N.E. Elam Young Pkwy.  
Hillsboro, OR 97124-6497  
Tel.: 800-955-5599

CIRCLE NO. 116 ON FREE INFORMATION CARD

*Introduction to Desktop Video*, \$34.95  
With CD-ROM (MIS:Press, 1995; available at better bookstores; autographed copies are available directly from Tom Benford:

**CPTS, Inc.**  
2329 Hwy. 34, Ste. 201  
Manasquan, NJ 08736

with the digitized video files to create completed productions (Fig. 17).

The wide assortment of media types that can be imported, including bitmaps, gives you lots of flexibility for creating interesting backgrounds and graphics you can combine and overlay with video sequences. The *DVP* software is powerful enough to produce anything from a serious business presentation to a music video and just about anything in between (Fig. 18).

## Closing Comment

The Intel Smart Video Recorder Pro card and Asymetrix *Digital Video Producer* software is a combination that's difficult to beat. At a cost of less than \$500, it makes high-quality digital desktop video a truly affordable reality for just about anyone who wants to get involved in this medium. But be forewarned—once you complete your first capture and start editing and adding effects with the *DVP* software, you'll be hooked. So lookout Kubrick, Spielberg, Lucas, *et al*—there's a whole new breed of folks out there with Smart Video Recorder Pro cards and Pentium PCs who are coming up fast!



Tom Benford

## Bits & Pieces By Alexander W. Burawa

### Clipart Library on CD-ROM

When the *DeskGallery ClipArt Library* software/book package from Zedcor, Inc. (4500 E. Speedway, Ste. 22, Tucson, AZ 85712-5305; tel.: 800-482-4567; fax: 602-881-1841) landed on my desk a week before Halloween last year, I felt that I had received an early Christmas present because it boasted more than 30,000 clipart images for PCs and the Macintosh. In fact, there are so many clipart images in this collection that it takes three CD-ROMs to accommodate all of them. The book that accompanies the CD-ROMs provides introductory notes and then devotes 500+ pages to catalog image after image in reduced form. The book images are arranged in alphabetical- and CD-ROM-order to provide a preview of every image contained on the three CD-ROMs, along with filenames for easy retrieval. An index at the back of the book provides yet another quick means for locating specific images for preview.

Supplied with the CD-ROMs and book are two quick-reference items. One is a Read Me First! card that contains important user information for PC (Windows), *WordPerfect* (Windows and DOS) and Mac users. The other is a letter-size chart that has Keywords on one side and Folders on the other side and lists, in alphabetical order, the categories covered and the category "folders" on each CD-ROM. You'll have occasion to use the Read Me card perhaps just once, during installation of the software. However, you'll want to keep handy the Keywords/Folders card for quick reference anytime you wish to use the CD-ROMs.

Clipart images on the CD-ROMs are arranged into 400 or so categories. Scanned images, to the tune of 22,500, are in .TIF format, while some 7,500 mechanical, electrical and architectural images are in .EPS format. All images are at 300-dpi resolution.

Images for this library come from Dover Publications' The Dover Clip-Art Series, Sunshine Publishing's Visual Delights, Berol Corp.'s RAPIDESIGN Drawing Symbols Library and Whelan Design Studios. The offerings cover just about every possible need and occasion, from accounting to zoology. As an example, I ran off a number of Halloween images from the Holidays-Fall-Halloween folder. A few weeks later, I ran off several Thanksgiving images from the Holidays-Fall-Misc folder. Less than a month after that, I ran off a sizable number of Yuletide images from the Holidays-Winter-Designs, Holidays-Winter Santa Claus and Holidays-Winter-Misc folders. All of these were on CD3. What I found really interesting during this period was how quickly children snapped up the printouts to color them with crayons (a great diversion for the little ones at any time of the year).

I didn't limit myself to viewing and printing out "holiday" images. I took circuitous tours of both CD1 and CD2 as well, viewing image after image at my leisure and printing out those that caught my fancy. In all cases, the images I printed out were sharp and well-defined—even those I ran out on a 28-pin dot-matrix printer. The "flavor" of each image depends on the period from which it was culled. That is, images that looked like they were created in the 1800s had the look of woodcuts and engravings, those that look like they originated in the Nouveau Art period in the first half of this century looked like linoleum cuts or chalk drawings. Just about every other artistic technique is represented in this clipart library.

Zedcor is quite liberal in its permission-to-use policy. Registered users can incorporate up to 15 *DeskGallery* images into a single project or publication. Furthermore, they can obtain from the company special permission to use more, if needed.

System requirements for using *DeskGallery* are modest. All you need is a Windows-compatible PC or Macintosh computer equipped with a CD-ROM drive. Even a single-speed CD-ROM drive will do.

*DeskGallery* lists at \$99.95, but I've seen it discounted to as little as \$49.95. This is much less than a cent per image, even at full list price, which is one heck of a deal for high-quality clipart images and one that you'll find difficult to match anywhere else. You'll find images here for just about every occasion and need, including an extensive collection of borders for fancy, business and everyday stationery use; sales and promotional events; military; architecture; arts; sciences; and a whole lot more.

CIRCLE NO. 232 ON FREE INFORMATION CARD

(Continued on page 105)

## Programmable Controller Comparison Chart

Family	Company	Product Name	Microcontroller	Program Memory Type/Size	RAM Size	I/O Bits/Access
PIC	Parallax	BASIC Stamp, BASIC Stamp I Module	15C56 PIC	EEPROM/256 Bytes	16 Bytes	Eight/Header
8051	Allen Systems	Little Byte-51 or 52	89C51 or 89C52	EEPROM/4K or 8K	128 or 256 + 512 Bytes EEPROM	30/Headers
8051	Blue Earth Research	Xplor-32	80C32	EEPROM/4K	256 Bytes	12/Patch Area, DB-25
8051	EE Systems	DsPLUG	DS2250T	Battery-Backed RAM/32K*	256 Bytes + 32K**	30/Wire Wrap Pins
8051	Iota Systems	SC-75	87C752	EEPROM/8K	24 Bytes	21/Headers
8051	LS Electronic Systems Design	EM32F	8031	Flash EEPROM/40K	8K	10/Header
8051	Micromint	Domino-52	80C32	EEPROM/32K	32K	14/Header
68HC11	CGN	CGN1001-232	68HC11E2	EEPROM/2K	256 Bytes	38/Wire Wrap Header
68HC11	LDG Electronics	SBC-2, SBC-E2	68HC11A1, 68HC811E2	EEPROM/512 Bytes, 2K	256	38/Solder Pads
68HC11	New Micros	NMIN-0021, 0121A, 0121	68HC11FN MaxForth	EEPROM/512 Bytes	256 Bytes	38/Headers
68HC11	Technological Arts	Adapt-11	68HC811E2	EEPROM/2K	256 Bytes	38/Header

\*Shared With Data Memory

\*\*Shared With Program Memory

age, which seals the circuits in a block of epoxy that's about the size of a domino.

You connect to the circuits via a 20-pin header that includes pins for an external +5-volt supply, 14 I/O bits and an RS-232, RS-422 or RS-485 link. For easy reference, pin functions are labeled on the package. An alternate \$99 version replaces two of the digital I/O bits with 12-bit analog inputs.



To program Domino, you need a three-conductor serial cable and a way to connect its conductors to the 20-pin header. I soldered three short wires to a female DB-25 solder-cup connector, plugged it into my serial cable's male connector and jumped the wires to Domino's header. This may not be an elegant way to go, but it's functional. An optional \$19 development board brings Domino's header pins out to screw-type terminals.

Though the RS-232 interface actually transmits at 5- and 0-volt levels, instead of RS-232's positive and negative voltages, most RS-232 ports will communicate with it without problems if you keep the cable short. If you add a MAX232 chip to obtain true RS-232 levels, remember that this chip's level shifters are also inverters. Hence, you have to re-invert the signals.

When you have the serial link connected, Domino is very much like any system that runs the popular BASIC-52 interpreter. The 97 commands, instructions and operators are virtually identical to BASIC-52's instruction set, including floating-point math.

Domino has six assembly-language utility routines that you can call from your BASIC programs. A PWM utility replaces and enhances BASIC-52's PWM instruction. Other utilities read the ADC inputs, measure frequency or period, access an I<sup>2</sup>C interface, and store programs in EEPROM. Unlike BASIC-52's PROG commands, the programming utility can store just one program at a time. (Storing a program erases the previous one.)

Since the utilities aren't part of BASIC-52, you have to use non-intuitive state-

Power Supply	Programming Language	PC Interface Type/Cable/Software Included	Dimensions (Inches)	Price (\$) System/Controller Only	Special Features
3 to 5 Volts Reg., 6 to 12 Volts Unreg.	BASIC Interpreter	Parallel/Yes/Yes	1.5 x 2.5, 1.4 x 0.4	138/128	Components Available Separately
5 Volts Reg. or 6 to 9 Volts Unreg.	Loads Binary, Intel Hex & S19 Files	Bidirectional Parallel/Yes/Yes	1.6 x 2.2	148/158 or 49/59	Programmer board is general-purpose device programmer
6 to 12 Volts Unreg.	BASIC Interpreter, Loads Intel Hex Files	Serial/No/No (Use Any Terminal Emulator)	2.2 x 2.2	99.95/59.95	Variety of enhanced versions & related products available
5 Volts	Loads Intel Hex Files	Serial/Yes/Yes	1 x 3.2	120/120	Real-time clock
6 to 12 Volts Unreg.	BASIC Interpreter	Parallel/No/Yes	2.5 x 5	250/109	<sup>1</sup> I <sup>2</sup> C interface, analog inputs
5 Volts, 12 Volts For Flash Programming	Loads Intel Hex Files	Serial/No (Available)/Any Terminal Emulator	3 x 4.3	80/80	Firmware monitor/Flash manager
5 Volts	BASIC Interpreter	Serial (RS-232, RS-422, RS-485)/No/Available or Use Any Terminal Emulator	1.1 x 1.8	94/79	Version with two 12-Bit ADC Inputs Available
5 Volts	Loads Motorola S-Records	Serial/No/Yes	2.8 x 2	45/55	Available Without 68HC11 or RS-232 Interface
5 Volts	Loads Motorola S-Records	Serial/No/Yes	3.1 x 3.6	59.95/79.95	SBC-8K Board Has 8K of Serial EEPROM
9 Volts ac or 5 Volts Reg., 5 Volts Reg. or Power by Serial Port	Forth Interpreter	Serial/No/No	4.2 x 2.3, 3.6 x 2.2, 1.5 x 2.5	70/69, 70/60, 85/75	MaxDDE Software Available For Windows Programming
7 to 15 Volts Unreg. or 5 Volts Reg.	Loads Motorola S-Records or Binary Files	Serial/Yes/Yes	2 x 2.8	74.95/69.90	Plugs Into Solderless Breadboard

ments like CALL 0F000H to run them (instead of ADC, for example).

A \$99 package of development tools includes Host-52 communications software, a BASIC-52 programming manual and a back-up copy of the utility routines on-disk. If you use your own terminal emulator, you can get by with just the \$15 BASIC-52 Programming Manual, which brings the price of a start-up system to \$94 or \$114, depending on Domino version selected.

## 68HC11 Family

Motorola's 68HC11 is a popular choice for tiny controllers because this chip has its own bootloader software that automatically loads a program received at the serial port into

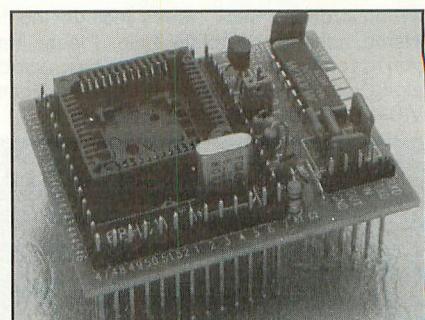
RAM. You can use the bootloader to load a small program (such as PCBUG11, available from Motorola's BBS) that, in turn, receives another program at the serial port and stores it in a 68HC11's on-chip EEPROM. All of the boards I looked at use this method to load programs.

Most 68HC11 versions have 38 port pins, in addition to a serial port. Thus, plenty of I/O is available. Eight bits can be configured as analog inputs.

### CGN CGN1001-232

CGN's Wire Wrap modules provide the basics of a 68HC11 circuit on a compact circuit board. On the \$45 CGN1001-32, you get a 68HC811E2 with 2K of EEPROM, an oscillator, a reset circuit (but

no reset switch), a mode-select jumper, an RS-232 interface and power-supply bypass capacitors. All 52 of the 68HC11's connections are brought out to Wire Wrap headers in the same rectangular format of the PLCC chip. The RS-232 interface is also brought out to Wire Wrap pins.



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The \$55 CGN1101-232 uses two ports as data and address buses to allow the 68HC11 to run in expanded multiplex mode.

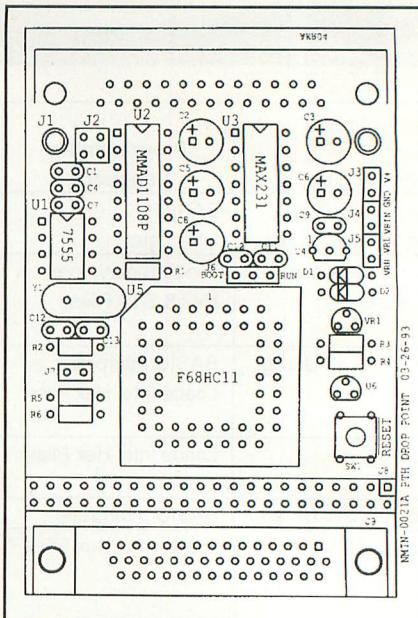
To use these boards, you connect the RS-232 interface to a personal computer and use CGN's \$10 software or Motorola's freeware to load your assembled program into the 68H's EEPROM.

The documentation consists of only a schematic diagram and a one-page explanation and illustration of how to use the board, plus a handy printed Wire Wrap ID sheet that fits over the pins on the solder side of the board. If you're already familiar with the 68HC11, these modules are a quick and convenient way to get a project started.

You can also buy the boards without the 68HC11 chip installed for \$20 less. Versions without an RS-232 interface are also available.

### LDG Electronics LDG-SBC-2

LDG's \$59.95 SBC-2 basic board has 512 bytes of EEPROM in a 68HC11A1 chip. If you need more program memory, the \$79.95 -E2 version has 2,048 bytes of EEPROM. The new SBC-8K adds 8K of program memory in a Xicor X68HC75 EEPROM. The boards have an RS-232 interface and provide solder pads for accessing I/O.



A disk contains BASICA and QBASIC programs that load files in S-record format from your computer into the EEPROM. You also get Motorola's freeware assembler and some simple but useful example programs.

Documentation includes a printed reference for the assembler, basic instructions for using the board, some detail about the hardware and software and Motorola's *HC11 Reference Manual and Programming Reference Guide*.

### New Micros NMIN-0021A/0121A/0121

I looked at three New Micros boards, each with an on-chip MaxForth interpreter. Forth has always had a dedicated following, though it's never been as popular as BASIC or C. With New Micros' MAXDDE software, you can also access these boards using Visual BASIC and other Windows programs, though some familiarity with Forth is still required.

The Forth language begins with a dictionary of defined words, which are somewhat like BASIC's reserved words. MaxForth has 311 words. You write a Forth program by building phrases from these words and defining new words that are then added to the dictionary. A final word names the program, which you run by typing its name. If you prefer assembly language, MaxForth permits in-line assembly code. So you can get by with a minimum of Forth programming, if you wish.

MaxForth has two modes that are similar to BASIC-52's command mode for immediate execution and run mode for entering program lines.

The MAXForth interpreter is programmed into the 68HC11's ROM. You

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### Technological Arts

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communicate with the boards over a serial link, using any terminal emulator. For storage of Forth programs, you're limited to using the 68HC11FN's 512 bytes of EEPROM.

The \$60 NMIN-0021A has solder pads for a 9-volt ac power supply, or you can connect a 9-volt unregulated or 5-volt regulated supply. The \$60 NMIN-0121A can use a 9-volt dc or 5-volt regulated dc supply. This board also has the ability to run without a conventional power supply.

Through ingenious use of a 555 timer, MAX231 RS-232 interface and voltage regulator, the NMIN-0121A's circuits can take their power from the RXD, DTR, RTS inputs on the RS-232 port. The circuits can "steal" around 20 mA, which is enough to power the board with some to spare for additional low-power components. This makes it easy to place a controller on a serial link without having to worry about providing power to it.

The NMIN-0121A uses through-hole components and has solder pads, in addition to a header for I/O connections. The \$75 NMIN-0121 is a smaller surface-mount version that doesn't have the solder pads. The new NMIN-0022A supports an RS-422 or RS-485 interface.

The documentation for the boards seemed complete, though I sometimes found it difficult to find what I was looking for. There's some documentation of MaxForth, but you'll also want the complete manual, which adds \$30 for the printed version or \$10 for the disk version to the price of a start-up system.

MAXDDE and *EasyA* are tools (available separately) that you can use to program the MaxForth boards from *Visual BASIC* or another *Windows* program that supports DDE (dynamic data exchange). The 68HC11 board runs the Forth program *EasyA*, which implements an *EasyA* protocol, or set of rules, for serial communication.

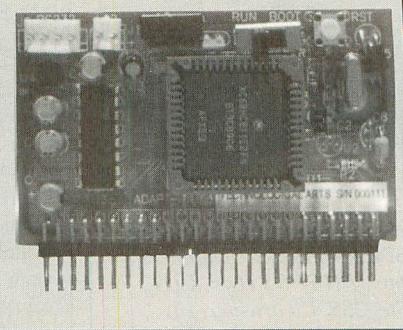
MAXDDE acts as a DDE server that controls exchange of information over the *EasyA* link. Your *Visual BASIC* program accesses the microcontroller by reading from and writing to MAXDDE.

*EasyA* includes code for monitoring four analog inputs, monitoring and debouncing four digital inputs and writing to four outputs. You can use *EasyA* as-is or modify it to suit your application.

Included with MAXDDE is an example *Visual BASIC* program that has a display of gauges, simulated LEDs and switches that display and control the states of port bits.

### Technological Arts Adapt-11

Technological Arts' Adapt-11 is designed to make it easy to add and test I/O circuits on a solderless breadboard. The board's power and I/O connections are brought



out to two rows of 25 pins that are spaced 0.3" apart and plug directly into the parallel rows of sockets in a breadboard. If you like to experiment, this board makes it easy to add and remove components.

The board's 68HC11E2 has 2K of EEPROM, which ships with a handy test program already stored in it. The program allows you to view and change port bits and generally verify that the board is working.

With this board, you also get a disk that contains Motorola's freeware assembler, a file loader and a demo program. There's some documentation on how to use the software to load programs into EEPROM, but familiarity with the 68HC11 and its bootloader mode will help a lot.

A complete package with the board, serial cable, disk, and Motorola's *Applications Handbook and Programming Reference Guide* costs \$74.95.

With the addition of a 12-volt programming potential, you can use the same board to program the -E9 version of the chip, which has 12K of EPROM.

## Moving on

You can reach me on Internet at [janaxel@aol.com](mailto:janaxel@aol.com), or by mail at Lakeview Research, 2209 Winnebago St, Madison, WI 53704. Comments, suggestions, etc. are welcome.



Jan Axelson



internal slots and 2M to 16M of RAM. *Husky Computers, Inc.*, 18167 US Hwy. 19 N., Ste. 285, Clearwater, FL 34624; tel.: 813-530-4141; fax: 813-536-9906.

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### Parallel-Port GPIB Controller

ICS Electronics' Model 4818 IEEE-488.2 Controller Module lets any IBM-compatible desktop or portable computer control GPIB bus devices from its parallel port. It's powered from the computer's auxiliary

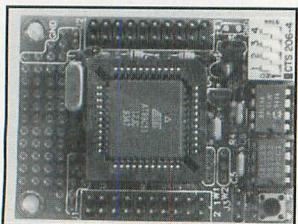


keyboard connector and doesn't require an external supply. The 4818's software includes 488 driver libraries, program examples and an Interactive Command Line program that lets you control GPIB devices from the keyboard without having to write a program. \$395. *ICS Electronics Corp.*, 473 Los Coches St., Milpitas, CA 95035; tel.: 408-263-5500; fax: 408-263-5896.

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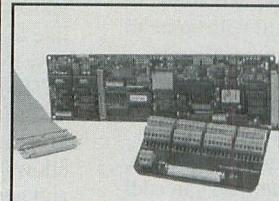
### 89C51 SBC

Allen Systems' LITTLE BYTE-51 89C51-based single-board computer measures just 1.6" x 2.25". This 8051-com-



### Multi-Sensor Interface Cards

Industrial Computer Source's Model MSI60x Series of multi-sensor interface cards provides a direct sensor-to-PC interface of up to 16 analog channels, while requiring absolutely no external signal conditioning. Inputs can be from any available combination of thermocouples, RTDs, potentiometers, resistances, strain gages, LVDTs and variable-reluctance pressure trans-



ducers, as well as low-level dc voltages. A 14-bit A/D resolution and 11 stages of programmable gain amplification permit accurate measurements from the sensor signal sources, with an analog conversion rate of 5,000 to 20,000 channels per second.

MSI Series cards also provide co-processing functions to minimize the host PC's computational overhead. \$1,795. *MSI601-U. Industrial Computer Source*, 9950 Barnes Canyon Rd., San Diego, CA 92121; tel.: 800-523-2320; fax: 619-677-0895.

CIRCLE NO. 21 ON FREE CARD

patible device runs at clock speeds up to 20 MHz and features 4K of EEPROM storage. \$49/\$69, 12 MHz/20 MHz. *Allen Systems*, 2346 Brandon Rd., Columbus, OH 43221; tel.: 614-488-7122.

CIRCLE NO. 22 ON FREE CARD

### Software

#### Windows IQ

Visual Entertainment's *IQ Test For Windows* offers a fully validated IQ test, complete with an explanation of test-score results. Targeted at an age group of 14 to adult, the test also features a brief intro-

ductory section on intelligence in general. \$14.95. *Virtual Entertainment, Inc.*, 200 Highland Ave., Needham, MA 02194; tel.: 617-449-7567; fax: 617-449-4887.

CIRCLE NO. 28 ON FREE CARD

### Windows CAD System

*ProCAD Advanced for Windows* Version 3.0 from Interactive CAD Systems is a schematic-capture and PCB-layout CAD package. This release had a built-in Gerber Importer/Viewer, Integrated Interactive Quick Router and seamless bidirectional interface to the Cooper and Chyan Technology Spectra shape-based router. \$320. *Interactive CAD Systems*, PO Box 4182, Santa Clara, CA 95056; tel.: 408-970-0852; fax: 408-986-0524.

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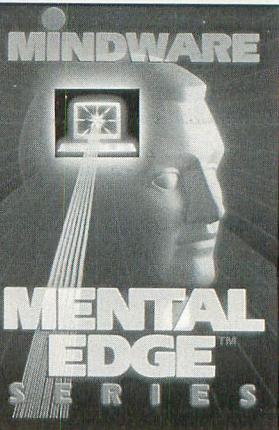
### Engineering Tool Box

UNIK Associates' *Engineering Tool Box* Windows-based software includes 101 different plant-engineering programs that deal with mechanical, structural and industrial engineering, as well as hydraulics, fluid mechanics, machine design, shop math, maintenance and miscellaneous subjects. \$295. *UNIK Associates*, 4065A N. Calhoun Rd., Brookfield, WI 53005; tel.: 414-781-3334; fax: 414-781-5335.

CIRCLE NO. 24 ON FREE CARD

### Self-Improvement Software

The Mindware Mental Edge Series consists of a collection of Windows and DOS-based self-improvement software packages. Titles include *IQ Builder* for testing and boosting IQ; idea-generation *ThunderThought*; career planning *Career Path*; *Neuron Expert IV With StockNet* stock-selection tool; *PC Therapist V* self-therapy program; *Color Test for Windows* for selecting colors that suit your personality;



*Motivation Advisor* motivation program from a leading consultant to Fortune 1,000 companies; and *Dream Analyzer* dream-interpretation package. \$10 each. *Mindware*, 1803 Mission St., Ste. 414, Santa Cruz, CA 95060; tel.: 408-427-9455; fax: 408-429-5302.

CIRCLE NO. 25 ON FREE CARD

### Windows Time Zones

The *WinZones Windows* utility from Extend displays multiple time-zone clocks simultaneously on a computer's video screen. It provides several customizable features that include digital or analog clock faces, optional date and seconds display, color selections, alarms and more. More than 100 major cities are programmed into the *WinZones* database, and new cities can easily be added. \$29.95. *Extend, Inc.*, 4847 Hopyard Rd., Ste. 3218, Pleasanton, CA 94588; tel.: 510-484-0395; 510-484-0153.

CIRCLE NO. 26 ON FREE CARD

### 3D Stereograms

Tardis Systems' *SIRDS* program lets you create 3D stereograms. It contains its own miniature CAD 3D object modeling system. The 3D graphics art produced by the program can be viewed without special glasses or a 3D viewer. \$39.95. *Tardis Systems*, 901 18 St., Ste. 301, Los Alamos, NM 87544; tel.: 505-662-9401; fax: 505-662-6780.

CIRCLE NO. 27 ON FREE CARD

## Navigating (from page 28)

consistent, abstract view of the specific capabilities and status of all PC Cards. While little change to Card Services is required to support CardBus, more-significant changes are required internal to Card Services to provide complete compatibility for both CardBus and non-CardBus. As with Socket Services, a minimum Card Services functionality is required. Each function on a CardBus card must be described by a CIS.

The CardBus interface also provides support for multi-function CardBus cards. Each card may be divided into one or more functions. There can be up to a maximum of eight functions per card.

An abundant variety of PCMCIA PC Cards exists on the market, including memory, hard-disk, fax/modem, LAN adapter, sound, SCSI, video-capture, data-acquisition and multi-function cards. Besides these are several products that aren't built onto a PC Card but instead use a card as an interface to a portable computer. Examples of these are external floppy-disk, hard-disk and CD ROM drives. Finally, there are socket-type products, known as PC Card reader/writers that provide a PCMCIA socket for a desktop computer.

## Storage Devices

A quick glance at the chart of PCMCIA products that accompanies this article shows that a great number are dedicated to mass storage. You'll find Flash and SRAM cards and hard drives in this group. Though the greatest-capacity Flash card shown on the chart is 40M, you should see 80M cards available later this year. These can be increased to 160M with *Stacker* data-compression software. For more about Flash RAM see the "What is Flash RAM?" box.

The greatest-capacity disk drives on the chart are at 260M, though capacities should rise to 420M in the near future. These have a Type III form factor, which is fine for many notebooks but too thick for most subnotebook computers that have Type II or Type I slots. Though there are no Type II hard drives listed on the chart, these are on the horizon at capacities of 85M and 121M.

**Fax/Modems.** PCMCIA modems and fax/modems break down into three

categories: traditional modems, cellular-ready modems and cellular modems. Traditional modems connect directly to telephone lines through an included cable or a pop-out RJ-11 connector. Cellular-ready modems connect to the telephone lines but can also be used with the cellular network by purchasing an optional adapter that connects to a cellular phone. Cellular modems come equipped to connect to the cellular network through a cellular phone, or they can connect to a standard telephone line.

Some cellular modems are designed to work with specific cellular phones. For instance, the Epson EFM144C connects directly to any Motorola MC2 data-capable modem. The fastest PCMCIA modems are now operating at 28.8K bps and comply with the V.34 standard.

**Sound.** The current crop of PCMCIA sound cards offers 16-bit sound (none offer wavetable technology, though). Some cards, such as the Apex Audio Express, have an integrated microphone built into the cable.

If your ultimate goal is multimedia on the desktop, and you have just one PCMCIA slot in your notebook PC, a combo card that includes sound plus an SCSI interface (such as the Multimedia Combo card from New Media, which includes both 16-bit stereo sound and an SCSI II interface in a Type II form factor) is probably a better choice than a stand-alone sound card.

**SCSI.** PCMCIA SCSI cards let you connect external devices like a CD ROM drive to your notebook PC. However, as mentioned above, these cards limit multimedia options if you have only one PCMCIA slot on your computer.

**Network Adapters.** Network adapter cards let you connect your notebook computer to server-based or peer-to-peer-type networks. Most LAN cards are Ethernet 10 Base-T, which uses twisted-pair cabling and RJ-11 connectors, or 10 Base-2, which uses thin RJ-58 coaxial cabling and BNC connectors. More-expensive combo cards offer both types. If you're interested in connecting together a small workgroup, keep in mind that 10 Base-T networks, though using simpler cabling, require a hub.

**Video-Capture Cards.** PCMCIA video-capture cards let you capture a

## Bits & Pieces (from page 97)

By Alexander W. Burawa

### Cruising the Internet

*Internet Chameleon* 4.1 (\$199.95 from NetManage, Inc., 10725 N. De Anza Blvd., Cupertino, CA 95014; tel.: 408-973-7171; fax: 408-973-8272) contains just about everything you need to get onto and navigate the information superhighway, including automatic registration for an account with your choice from among several service providers. This is a great way to go if you've never worked the World Wide Web (WWW). If you already have an account, the User's Guide tells you how to set up *Internet Chameleon* for it.

All you need to navigate the world of cyberspace with *Internet Chameleon* are a personal computer and a modem. This comprehensive package for beginner and old hand alike includes in its bag of tricks Instant Internet, a utility that lets you sign up for an Internet account on-line and automatically configures your software for connection to the Internet. When you're set up and ready to go, you take the next step by calling up a Custom utility, through which you actually connect to the Internet and which customizes your account connection.

Once you're plugged into the Internet, you have 10 more utilities that make life easy. With WebSurfer, you can browse hypertext documents published on WWW servers. With Gopher, you can browse public Gopher information servers, while with Archie you can retrieve public-domain files from anonymous FTP hosts. A Mail utility lets you send and receive electronic mail. With FTP Client, you can connect to FTP servers and transfer files to and from remote computers, and FTP Server permits other Internet users to directly access files on your PC. Moving on to NEWTNews, you can subscribe to news groups on the Internet and read and post articles, and you use Telnet to log onto remote computers on the Internet and emulate various ASCII terminals.

Four other utilities are provided in this package to make your surfing life easier. Mail Utilities provides additional functions for managing Mail. Ping checks your connection to a specified computer. Finger displays information about users on a specified computer. Finally WhoIs provides information about other network users, including their telephone numbers and e-mail addresses.

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video clip or a single frame to your notebook PC. Cards like Quadrant's CardCam-VideoIN accept composite and S-video inputs and produce video still captures in 24-bit 640 x 480-pixel resolution and motion video at 15 frames per second at 320 x 240-pixel resolution.

**Multi-Function Cards.** Multi-function cards are beginning to proliferate in the PCMCIA form factor, just as they did years ago for the ISA bus. But you won't find cards that offer more than two functions just yet. Typically, multi-function cards combine a network adapter and fax/modem or a peripheral connection and sound, though some offer a network adapter with sound. Examples are the Apex MultiCard combination Ethernet adapter and data/fax modem, the New Media Multimedia Combo combination sound and SCSI II card and the Ositech King of Diamonds combination sound and network adapter card.

#### **External Drives With PC Card Interface.**

If you want to connect an external CD-ROM, floppy-disk or hard-disk drive to your notebook PC, you can do so with products that combine the external drive with a PCMCIA interface card. Products like the Panasonic KXL-D720 combine a PCMCIA Type II SCSI interface card with a battery-operated, double-speed CD-ROM drive. An alternative is to purchase a PCMCIA SCSI card and whatever SCSI peripheral you'd like.

**Wireless.** PCMCIA wireless pagers let you receive wireless messages on your notebook computer. These pagers also operate in stand-alone mode as conventional alphanumeric or beeper pagers. Examples are the PageCard from Socket Communications and the NewsCard Wireless Data Receiver from Motorola.

**Reader/Writers.** As PCMCIA migrates from portable computers to the desktop, you'll see more and more PCMCIA reader/writers in desktop machines. These devices usually have a 3 1/2" form factor and fit anywhere you'd ordinarily insert a floppy-disk drive. If you want to save a bay, you might be happier with a combo 3 1/2" floppy drive and PCMCIA reader/writer like the DYO from Epson, which combines a Type III PCMCIA socket with a 3 1/2" 1.44M floppy-disk drive.

**Miscellaneous.** Besides the common

functions listed above, you'll also find other types of products in the PCMCIA form factor. For example, National Semiconductor's DAQCard-700 is a data-acquisition unit that has a 12-bit A/D converter and 16 single-ended or eight differential inputs, among other features. National also sells the PCMCIA-GPIB high-performance IEEE-488 interface.

Another example is the DARTdsp, which includes the AT&T DSP3210 digital signal processor (DSP) on-board and is designed for audio signal-processing applications.

Finally, Socket's Mobile GPS is a global positioning system that turns your notebook PC into a satellite receiver that's capable of determining your current position on Earth and velocity and gives you the time based on an atomic-clock standard.

## Reviews

The final part of our PCMCIA maze map consists of hands-on reviews of two new PCMCIA products. One is TDK's DF2814 a 28.8K-bps data/fax modem and the other is Quadrant's CardCam-VideoIN video-capture card. The purpose of these reviews is to give you a hands-on look at what it takes to get two typical PCMCIA cards working in a notebook computer.

The test machine for these reviews was a Toshiba T3400CT subnotebook computer with an active-matrix color display. The system used Phoenix-CARD Manager Plus Version 3.00, Toshiba PCMCIA 2.10 Socket Services Version 1.00, Phoenix PCMCIA Card Services 2.10 Version 1.00, Phoenix Resource Management Utility Version 1.00, Phoenix Super Client Driver Version 1.00, Phoenix ATA and Memory Card Driver Version 1.00, Phoenix Flash File System Driver Version 1.00 and Microsoft Flash File System Version 2.00b. These all came pre-loaded on the computer and are installed during boot-up.

When you run *Windows*, one of the Program Groups that came pre-installed on the computer is the Toshiba Card Manager. This has a single icon, PCMCWin, which is the PCMCIA Card Information and Configuration Utility Version 1.00. This is the software Toshiba provides to assist you in installing PCMCIA PC Cards. Toshiba also bundled Traveling Soft-

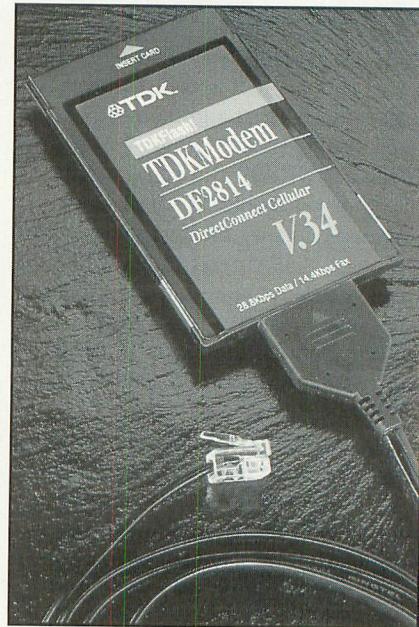
ware's *CommWorks for Windows* with the computer, which I used for testing the TDK DF2814.

### **TDK DF2814 Data/Fax Modem**

Though you might associate TDK with audio and video tapes, the company also manufactures a wide range of electronic components and materials. An offshoot of TDK Corp., TDK Systems, was founded in 1992 to develop and market peripherals for the domestic and global portable-computing marketplace. The DF2814 Data/Fax Modem reviewed here is a product of TDK Systems that lists for \$499.

The DF2814 is a PCMCIA Type II PC Card data/fax modem that operates at 28.8K bps for data and 14.4K bps for fax. The card is fully compliant with the ITU-T V.34 specification and supports V.42bis and MNP 5 data compression and V.42 and MNP 2-4 error correction. It includes a 16C550A-compatible UART and provides advanced parallel technology (APT), which is an ultra-high-speed parallel port with a *Windows* 3.1 driver that provides transfer rates up to 300K bps. The DF2814 integrates the telephone line Data Access Arrangement (DAA) circuitry directly on the card. Flash memory resides on the card, which means that software can be upgraded by the user.

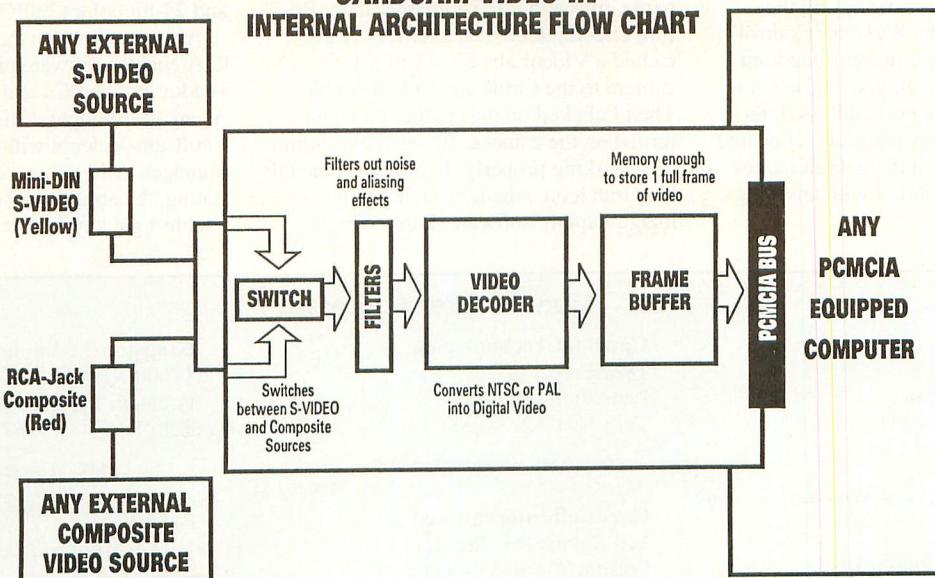
Bundled with the DF2814 are *QuickLink II* fax and telecommunications software for *Windows* and DOS. The package also includes a cable with a PCMCIA standard seven-pin connector, a disk with



TDK DF2814 Data/Fax Modem Card operates at 28.8K bps and subscribes to V.34 standard. Modem is cellular ready, which means it can be connected to most data-ready cellular telephones with purchase of an optional cable.

## HARDWARE:

### CARDCAM-VIDEO IN™ INTERNAL ARCHITECTURE FLOW CHART



Block diagram of CardCam Video In video capture card.

PCMCIA Modem Card software (for portables that don't have PCMCIA Card and Socket Services), a female-to-female RJ-11C coupler and a 64-page User's Manual. The modem also includes Direct Connect Cellular (DCC) technology, which allows the card to connect directly to popular cellular telephones via an optional cable, and MNP 10 Adverse Channel protocol for reliable connections.

According to the "Quick Installation" instructions in the TDK User's Manual: "If your computer incorporates a Card and Socket Services package that meets PCMCIA Release 2.01 specifications, installation requires nothing more than to insert the DF2814 card into the slot and use the applications software." Since this sounded easy enough, I inserted the modem card and tried to make a connection. No luck. I decided to take a look at the Toshiba Card Manager.

The Card Manager's PCMWIn utility gave me information on the card, but it showed that it hadn't been configured. I then configured the modem for operation on COM2 and tried again. This didn't work, either. At this point, I went back to the manual, which suggested that I try a TDK utility that looks for the modem. When I ran the utility, it couldn't find the modem.

Rather than continue on by myself, I decided to place a call to TDK's technical support. The person with whom I spoke asked me to run Microsoft's MSD utility. This confirmed that COM2 wasn't being recognized. After making a few changes to my CONFIG.SYS file—without success—I was advised to run another TDK

utility called ENABLER.EXE. This got the modem to work.

ENABLER.EXE overrides the Phoenix Card Services already installed on the machine, thus taking away any PC Card hot-swapping capability. I wasn't altogether happy with this solution, and neither was the TDK support person. He promised to check further into the matter so that I could get the modem working with the Phoenix Card Services.

With the modem now working, I attempted to connect to a few electronic mail and information services using CommWorks. Now that the port was enabled, everything worked well.

I wasn't able to try the Parallel Port Modem (PPM) features of the DF2814 for a couple of reasons. To begin with, I needed another modem that had this capability, which I didn't have on hand. Then the TDK PPM driver doesn't operate with the Toshiba T3400CT. According to tech support, there's a small glitch in the program, which TDK is trying to correct. (The parallel port referred to here isn't the parallel port on the computer, but the one built into the modem.)

This review should give you a better idea of what navigating the PCMCIA maze is all about. If there were no incompatibilities with the Phoenix Card Services, the modem probably would have worked right out of the box. Even with the problems, TDK provided a reasonable alternative that got the modem working, but it took some time to implement the solution.

The TDK DF2814 data/fax modem itself is quite a sophisticated piece of elec-

tronic equipment. Not only does it allow you to operate at the maximum speed available today through a serial port (28.8K bps), but it also lets you further increase transmission speed with the parallel-port option. At a suggested retail price of \$500, however, you have to really need the DF2814's advanced features to justify its purchase.

#### Quadrant CardCam-VideoIn

Quadrant's \$400 CardCam-VideoIn PCMCIA Type II real-time video-capture card offers both composite and S-video inputs right on the card. It accepts video signals from most standard video sources, such as a camcorder or VCR.

CardCam-VideoIn features True-Color frame grabbing, which means that it can capture full 24-bit image data and store it as a standard Windows bitmap (.BMP) or Video for Windows (.AVI) file. The card can capture and display still images in: 640 x 480, 320 x 240, 160 x 120 and 80 x 60 resolution.

CardCam-VideoIn also features color motion video. It can capture a motion-video stream from a live or taped video source at up to 15 frames per second and up to 320 x 240 resolution (eight-bit).

The package includes the card, a cable with both S-video and composite female connectors, a 32-page manual, a disk with *Video for Windows* Version 1.1 and a disk with the PCMCIA driver, an install utility and Video Grab image-processing software. The complete package sells for \$400 plus \$19 shipping direct from the company.

I began the installation by loading the software onto the T3400CT through *Windows*. During installation, the CardCam-VideoIn setup program brings up the Drivers section of the *Windows* Control Panel. Clicking on the driver (Quadrant CardCam Driver V1.0), you can see system resources—base port address, interrupt and base memory address—allocated to the card. I accepted the default values, since these didn't conflict with anything else in the system.

The installation procedure loads a Program Group into *Windows*, called QI Vid-Grab, that contains an icon of the same name, plus a PCMCIA enabler icon. Before clicking on the enabler icon, I attached a VideoLabs FlexCam S-video camera to the CardCam-VideoIn cable. Then I clicked on the enabler icon and turned on the camera. To see if everything was working properly, I clicked on the QI VidGrab icon, which brought up the image-capture software. Sure enough,

since the camera was pointing my way, I saw an image of myself on the computer screen. I captured black-and-white (77K) and 24-bit color (230K) images.

As happened with the modem, PCMCIA enabler software provided by the vendor got the PC Card working quickly. As an afterthought, I tried to configure the CardCam-VideoIn with the Toshiba Card Manager. All I got was an error message stating "Unable to read card's CIS." I couldn't get any further than this. Natur-

### Manufacturer Addresses

**3COM Corp.**  
PO Box 58145  
6400 Bayfront Plaza  
Santa Clara, CA 99052  
Tel.: 1-800-NET-3COM

CIRCLE NO. 180 ON FREE INFORMATION CARD

**Accurite Technologies, Inc.**  
231 Charcot Ave.  
San Jose, CA 95131-1107  
Tel.: 1-408-433-1980

CIRCLE NO. 181 ON FREE INFORMATION CARD

**AMP, Inc.**  
PO Box 3608  
Harrisburg, PA 17105  
Tel.: 1-800-522-6752

CIRCLE NO. 182 ON FREE INFORMATION CARD

**Angia Communications Inc.**  
441 E. Bay Blvd.  
PO Box 505040  
Provo, UT 84606  
Tel.: 1-800-877-9159

CIRCLE NO. 183 ON FREE INFORMATION CARD

**Apex Data Inc.**  
6624 Owens Dr.  
Pleasanton, CA 94588-3334  
Tel.: 1-800-841-2739

CIRCLE NO. 184 ON FREE INFORMATION CARD

**AT & T Paradyne**  
8545 126 Ave. N.  
Largo, FL 34649  
Tel.: 1-800-554-4996

CIRCLE NO. 185 ON FREE INFORMATION CARD

**Axonix Corp.**  
844 S. 200 E.  
Salt Lake City, UT 84111  
Tel.: 1-800-866-9797

CIRCLE NO. 186 ON FREE INFORMATION CARD

**Cardinal Technologies**  
1827 Freedom Rd.  
Lancaster, PA 17601  
Tel.: 1-717-293-3000

CIRCLE NO. 187 ON FREE INFORMATION CARD

**Cardwell International**  
110 Ravine Rd., Ste. 156  
Folsom, CA 95630-4712  
Tel.: 1-916-985-1880

CIRCLE NO. 188 ON FREE INFORMATION CARD

**Centennial Technologies Inc.**  
37 Manning Rd.  
Billerica, MA 01821  
Tel.: 1-508-670-0646

CIRCLE NO. 189 ON FREE INFORMATION CARD

**Communication Automation & Control**  
1642 Union Blvd., Ste. 200  
Allentown, PA 18103  
Tel.: 1-800-367-6735

CIRCLE NO. 190 ON FREE INFORMATION CARD

**Epson America, Inc.**  
20770 Madrona Ave.  
Torrance, CA 90503  
Tel.: 1-800-433-3597

CIRCLE NO. 191 ON FREE INFORMATION CARD

**EXP Computer, Inc.**  
223 Micro Dr.  
Syosset, NY 11791  
Tel.: 1-516-496-3703

CIRCLE NO. 192 ON FREE INFORMATION CARD

**I/O Magic**  
199 Technology Dr., Bldg. 140  
Irvine, CA 92718  
Tel.: 1-714-727-7466

CIRCLE NO. 193 ON FREE INFORMATION CARD

**IBM PC Co.**  
Rte. 100, Bldg. 3  
PO Box 100  
Somers, NY 10589  
Tel.: 1-800-IBM-2YOU

CIRCLE NO. 194 ON FREE INFORMATION CARD

**Kingston Technology Corp.**  
17600 Newhope St.  
Fountain Valley, CA 92708  
Tel.: 1-800-835-6575

CIRCLE NO. 195 ON FREE INFORMATION CARD

**LIKSYS**  
1611A Millikan Ave.  
Irvine, CA 92714  
Tel.: 1-800-546-5797

CIRCLE NO. 196 ON FREE INFORMATION CARD

**Maxtor Corp.**  
211 River Oaks Pkwy.  
San Jose, CA 95134  
Tel.: 1-408-432-1700

CIRCLE NO. 197 ON FREE INFORMATION CARD

**Megahertz Corp.**  
605 N. 5600 W.  
PO Box 16020  
Salt Lake City, UT 84116  
Tel.: 1-801-320-7777

CIRCLE NO. 198 ON FREE INFORMATION CARD

**Ministor Peripherals Corp.**  
2801 Orchard Pkwy.  
San Jose, CA 95134  
Tel.: 1-800-943-0165

CIRCLE NO. 199 ON FREE INFORMATION CARD

**Motorola**  
One Memorial Dr.  
Cambridge, MA 02142  
Tel.: 800-488-8157

CIRCLE NO. 200 ON FREE INFORMATION CARD

**National Instruments**  
6504 Bridgepoint Pkwy.  
Austin, TX 78730-5039  
Tel.: 1-800-433-3488

CIRCLE NO. 201 ON FREE INFORMATION CARD

**National Semiconductor**  
1111 W. Bardin Rd., Mail Stop A 2300  
Arlington, TX 76017  
Tel.: 1-800-272-9959

CIRCLE NO. 202 ON FREE INFORMATION CARD

ally, since the enabler for this card overrides Toshiba Card Services, hot swapping is defeated.

CardCam-VideoIn is a great addition to a portable arsenal for anyone who wants to add motion video or still frames to presentations or databases, especially while on the go.

## Conclusion

It should be obvious from the differ-

ent parts of this article that the PCMCIA specification is still evolving and has a long way to go. Apparently, vendors are still not certain how to make their products work seamlessly with the current PCMCIA specification. Hopefully, they'll fare better with the new specification. Users bear the brunt of these compatibility problems, wasting time installing peripherals or not being able to take advan-

tage of the full power of their peripherals or the PCMCIA specification.

The bottom line is that PCMCIA PC Cards are here to stay, and it seems that they work well enough to keep most people happy. The next wave of cards should be more powerful and more compatible than the current crop as the new PC Card Standard takes hold. We look forward to it.

**New Media Corp.**  
One Technology, Bldg. A.  
Irvine, CA 92718  
Tel.: 1-800-453-0550

CIRCLE NO. 203 ON FREE INFORMATION CARD

**Noteworthy**  
PO Box 25505  
Tempe, AZ 85285  
Tel.: 1-800-959-4100

CIRCLE NO. 204 ON FREE INFORMATION CARD

**NovaLink Technologies, Inc.**  
48511 Warm Springs Blvd., Ste. 208  
Fremont, CA 94539  
Tel.: 1-510-249-9777

CIRCLE NO. 205 ON FREE INFORMATION CARD

**Ositech Communications**  
679 Southgate Dr.  
Guelph, Ontario, Canada N1G 4S2  
Tel.: 1-800-563-2386

CIRCLE NO. 206 ON FREE INFORMATION CARD

**Panasonic Communications & Systems Co.**  
Two Panasonic Way  
Secaucus, NJ 07094  
Tel.: 1-800-726-2797

CIRCLE NO. 207 ON FREE INFORMATION CARD

**Practical Peripherals Inc.**  
375 Conejo Ridge Ave.  
Thousand Oaks, CA 91361  
Tel.: 1-800-442-4774

CIRCLE NO. 208 ON FREE INFORMATION CARD

**Premax**  
17702 Mitchell N.  
Irvine, CA 92714  
Tel.: 1-714-851-8242

CIRCLE NO. 209 ON FREE INFORMATION CARD

**Qlogic Corp.**  
3545 Harbor Blvd.  
Costa Mesa, CA 92626  
Tel.: 1-800-867-7274

CIRCLE NO. 211 ON FREE INFORMATION CARD

**Quadrant International, Inc.**  
65 Valley Stream Pkwy., Ste. 250  
Malvern, PA 19355-1460  
Tel.: 1-610-251-9999

CIRCLE NO. 212 ON FREE INFORMATION CARD

**SCM Microsystems**  
131 Albright Way  
Los Gatos, CA 95030  
Tel.: 1-408-370-4888

CIRCLE NO. 213 ON FREE INFORMATION CARD

**Silicom Connectivity Solutions, Inc.**  
16650 NE 79 St., Ste. 101  
Redmond, WA 98052  
Tel.: 1-206-882-7995

CIRCLE NO. 214 ON FREE INFORMATION CARD

**Smart Modular Technologies**  
45531 Northport Loop W.  
Fremont, CA 94538  
Tel.: 1-800-536-1231

CIRCLE NO. 215 ON FREE INFORMATION CARD

**Socket Communications, Inc.**  
6500 Kaiser Dr.  
Fremont, CA 94555  
Tel.: 1-800-552-3300

CIRCLE NO. 216 ON FREE INFORMATION CARD

**Sundisk Corp.**  
3270 Jay St.  
Santa Clara, CA 95054  
Tel.: 1-408-562-0500

CIRCLE NO. 217 ON FREE INFORMATION CARD

**Sycard Technology**  
1180-F Miraloma Way  
Sunnyvale, CA 94086  
Tel.: 1-408-247-0730

CIRCLE NO. 218 ON FREE INFORMATION CARD

**Syquest Technology**  
47071 Bayside Pkwy.  
Fremont, CA 94538  
Tel.: 1-800-245-2278

CIRCLE NO. 219 ON FREE INFORMATION CARD

**TDK Systems**  
1600 Feehanville Dr.  
Mt. Prospect, IL 60056  
Tel.: 1-800-999-4TDK

CIRCLE NO. 220 ON FREE INFORMATION CARD

**Toshiba Corp.**  
9775 Toledo Way  
Irvine, CA 92718  
Tel.: 1-714-455-2000

CIRCLE NO. 221 ON FREE INFORMATION CARD

**US Robotics**  
7770 N. Frontage Rd.  
Skokie, IL 60077  
Tel.: 1-800-DIAL-USR

CIRCLE NO. 222 ON FREE INFORMATION CARD

**Ven-Tel Modems**  
2121 Zanker Rd.  
San Jose, CA 95131  
Tel.: 1-800-538-5121

CIRCLE NO. 223 ON FREE INFORMATION CARD

**Xircom Inc.**  
2300 Corporate Center Dr.  
Thousand Oaks, CA 91320  
Tel.: 1-800-874-4428

CIRCLE NO. 224 ON FREE INFORMATION CARD

**Zenith Data Systems**  
2150 E. Lake Cook Rd.  
Buffalo Grove, IL 60089  
Tel.: 1-800-227-3360

CIRCLE NO. 225 ON FREE INFORMATION CARD

## Alternative Input Devices (from page 45)

pensive package and comes with an audio waveform editor, Talking Scheduler that stores and reads appointments and comments, general-purpose Reader text-to-speech utility that reads any Windows text, and a microphone.

With *TextAssist*, you need at least an 80386 PC with 4M of RAM and a Sound Blaster Pro-compatible sound card. The program recognizes active Windows applications and automatically extracts their commands, but you still must train it to your voice.

You can build vocabularies of 1024 voice commands for 30 Windows ap-

plications. Besides saving voice training for up to 256 different people with 29,000 commands per user, you can get started quickly with generic male or female training and 32 built-in Windows words. The built-in generic training and automatic command extraction for Windows applications reduce the time from product purchase to voice command and control.

*VoiceAssist* and *TextAssist* come packaged with the \$199.95 Sound Blaster 16 ASP; \$249.95 Sound Blaster 16 MultiCD that also includes a CD-ROM interface for Creative, Mitsumi and Sony CD-ROM drives;

\$279.95 Sound Blaster 16 SCSI-2 that features compatibility with SCSI-1 and SCSI-2 device; and \$399.95 Sound Blaster AWE32 with Emu System's *Advanced WavEffects* synthesis for pro-audio sound that features 32-note symphonic-quality MIDI playback and digital signal processing.

MediaVision's \$229 Pro Audio Studio 16 and \$189 Pro Audio Spectrum 16 cards are packaged with *ExecuVoice for Windows* voice-command software, *Monologue for Windows* text-to-speech synthesizer for proofreading Windows text and a Sound Editor. Each card is also

### Companies Mentioned

#### Keyboards

Adjustable Keyboard  
**Apple Computers, Inc.**  
20525 Mariani Ave.  
Cupertino, CA 95014  
Tel.: 800 776-2333 or 408 996-1010

CIRCLE NO. 136 ON FREE INFORMATION CARD

MyKey  
**Ergonomix, Inc.**  
525-K E. Market St., Box 295  
Leesburg, VA 22075  
Tel.: 800 784-1047; fax: 703 771-1137

CIRCLE NO. 137 ON FREE INFORMATION CARD

Comfort Keyboard  
**Health Care Keyboard, Inc.**  
12040G W. Ferrick St.  
Wauwasota, WI 53222  
Tel.: 414 536-2160; fax: 414 536-2170

CIRCLE NO. 138 ON FREE INFORMATION CARD

BAT Keyboard  
**Infogrip, Inc.**  
1141 E. Main St.  
Ventura, CA 93000-1  
Tel.: 800 397-0921; fax: 805-652-0880

CIRCLE NO. 139 ON FREE INFORMATION CARD

Starpoint 101  
**Jefferson Computer Products**  
23454 25 Ave. S.  
Seattle, WA 98198  
Tel.: 206 824-1111; fax: 206-824-0941

CIRCLE NO. 140 ON FREE INFORMATION CARD

FlexPro  
**Key Tronic Corp.**  
PO Box 14687  
Spokane, WA 99214-0687  
Tel.: 800 262-6006; fax: 509-927-5248

CIRCLE NO. 141 ON FREE INFORMATION CARD

#### Ergonomic Keyboard

**Kinesis Corp.**  
22232 17 Ave. SE  
Bothell, WA 98021-7425  
Tel.: 800 454-6374; fax: 206 402-8181

CIRCLE NO. 142 ON FREE INFORMATION CARD

Pointing Stick, Select-Ease, Classic Touch,  
QT Enhanced  
**Lexmark Int'l.**  
740 New Circle Rd., NW  
Lexington, KY 40511-1876  
Tel.: 800 438-2468; fax: 606-232-7720

CIRCLE NO. 143 ON FREE INFORMATION CARD

MiniErgo Keyboard  
**Marquardt Switches Inc.**  
2711 Rte. 20 E.  
Cazenovia, NY 13035  
Tel.: 1-800-222-ERGO;  
fax: 315-655-8042

CIRCLE NO. 144 ON FREE INFORMATION CARD

Natural Keyboard  
**Microsoft Corp.**  
One Microsoft Way  
Redmond, WA 98052  
Tel.: 206 882-8080; fax: 206 883-8101

CIRCLE NO. 145 ON FREE INFORMATION CARD

#### Pointing Devices

GlidePoint  
**Cirque Corp.**  
2850 E. 3300 S.  
Salt Lake City, UT 84109  
Tel.: 800 454-3375 or 801 467-1100;  
fax: 801 467-0208

CIRCLE NO. 146 ON FREE INFORMATION CARD

RemotePoint  
**Interlink Electronics, Inc.**  
546 Flynn Rd.  
Camarillo, CA 93012  
Tel.: 805 484-1331; fax: 805-484-8989

CIRCLE NO. 147 ON FREE INFORMATION CARD

#### ClikMate, Trakmate

**Key Tronics Corp.**  
PO Box 14687  
Spokane, WA 99214-0687  
Tel.: 800-262-6006 or 509 928-8000;  
fax: 509-927-5248

CIRCLE NO. 148 ON FREE INFORMATION CARD

MouseMan, Trackman, Cordless Mouse  
**Logitech Corp.**  
6505 Kaiser Dr.  
Fremont, CA 94555  
Tel.: 800 936-0082; fax: 1-800-245-0000

CIRCLE NO. 149 ON FREE INFORMATION CARD

Mouse Version 2.0  
**Microsoft Corp.**  
One Microsoft Way  
Redmond, WA 98052  
Tel.: 206 882-8080; fax: 206 883-8101

CIRCLE NO. 150 ON FREE INFORMATION CARD

#### Tablets & Pads

ACECAT II  
**ACECAD Digitizers, Inc.**  
2600 Garden Rd., Ste. 111  
Monterey, CA 93940  
Tel.: 800-676-4223 or 408 655-1900;  
fax: 408-655-1919

CIRCLE NO. 151 ON FREE INFORMATION CARD

DrawingBoard III  
**CalComp, Inc.**  
2411 W. La Palma Ave.  
Anaheim, CA 92801  
Tel.: 714 821-2000

CIRCLE NO. 152 ON FREE INFORMATION CARD

Handwriter  
**Communications Intelligence Corp.**  
275 Shoreline Dr., 6th Floor  
Redwood Shores, CA 94065-1413  
Tel.: 800 888-9242

CIRCLE NO. 153 ON FREE INFORMATION CARD

equipped with a SCSI connector port for a CD-ROM drive.

• **Voice-Dictation Programs.** IBM's *VoiceType Dictation*, formerly called the *Personal Dictation System* (*IPDS*), converts the spoken word to PC-based text and provides an important tool for addressing the RSI epidemic currently plaguing personal-computer users. Priced around \$1,000, it's also a great comfort to people who suffer from RSI from keyboarding text.

The software comes with a half-length ISA or MicroChannel expansion card that contains a digital signal

processor and headset microphone. It requires OS/2 2.1 on at least an 80486 with 8M of RAM (16M is highly recommended) and about 65M of available hard-drive space.

Voice training for this product takes some time. It learns to recognize your voice by having you read an essay and a Mark Twain short story into the microphone for two hours. Once *VoiceType* has learned your voice, it continues to learn from errors it makes as you begin to use the program.

*VoiceType* isn't a continuous speech-recognition program. Rather,

it's a discrete-word-based one. It requires a short break before and after each word. The resulting mathematical model of your voice lets the system recognize up to 32,000 words. To this base vocabulary, you can add 2,000 words by pronouncing them into the microphone, typing them on-screen and linking the two. Custom vocabularies available for journalism for \$499 require 14M of additional hard-drive space, radiology for \$599 require 17M and emergency medicine for \$499 require 13M.

Once you get used to the discrete way of speaking, the system inputs

**AeroDuet**  
**Creative Labs, Inc.**  
1901 McCarthy Blvd.  
Milpitas, CA 95035  
Tel.: 800 998-5227 or 408 428-6600;  
fax: 408 428-6611

CIRCLE NO. 154 ON FREE INFORMATION CARD

**MP100 Writing Pad**  
**Inforite Corp.**  
1670 S. Amphlett Blvd., Ste. 100  
San Mateo, CA 94402  
Tel.: 800 366-4635 or 415 571-8766;  
fax: 415 571-7547

CIRCLE NO. 155 ON FREE INFORMATION CARD

**Ultima**  
**GTCO Corp.**  
7125 Riverwood Dr.  
Columbia, MD 21046  
Tel.: 800 344-4723; fax: 410-290-9065

CIRCLE NO. 156 ON FREE INFORMATION CARD

**Multipad**  
**Hitachi Corp.**  
250 E. Caribbean Dr.  
Sunnyvale, CA 94089  
Tel.: 408 747-0777

CIRCLE NO. 157 ON FREE INFORMATION CARD

**Genius EasyPainter**  
**KYE Int'l. Corp.**  
2605 E. Cedar St.  
Ontario, CA 91761  
Tel.: 800 456-7593; fax: 909 923-5494

CIRCLE NO. 158 ON FREE INFORMATION CARD

**XGT Series, PenMouse**  
**Kurta Corp.**  
3007 E. Chambers  
Phoenix, AZ 85040  
Tel.: 800-445-8782 or 602 276-5533  
fax: 602 276-9007

CIRCLE NO. 159 ON FREE INFORMATION CARD

**GraphicMaster II**  
**Numonics Corp.**  
101 Commerce Dr.  
Montgomeryville, PA 18936  
Tel.: 800 523-6716

CIRCLE NO. 160 ON FREE INFORMATION CARD

**RDT-1212**  
**Scriptel Corp.**  
4145 Arlingate Plaza  
Columbus, OH 43228  
Tel.: 614 276-8402; fax: 614-276-7615

CIRCLE NO. 161 ON FREE INFORMATION CARD

**SummaSketch FX**  
**Summagraphics, Inc.**  
8500 Cameron Rd.  
Austin, TX 78754  
Tel.: 1-800-444-3425; fax: 512-873-1329

CIRCLE NO. 162 ON FREE INFORMATION CARD

**ArtZ, ArtPad**  
**Wacom Technology, Inc.**  
501 SE Columbia Shores Blvd.  
Vancouver, WA 98661  
Tel.: 800 922-6613 or 206 750-8882;  
fax: 206 750-8924

CIRCLE NO. 163 ON FREE INFORMATION CARD

**Pen Direct for Windows**  
**FTG Data Systems, Inc.**  
8381 Katella Ave.  
Stanton, CA 90680  
Tel.: 800 962-3900 or 714 995-3900;  
fax: 714 995-3989

CIRCLE NO. 164 ON FREE INFORMATION CARD

#### Touch Screens

**Touch Frame**  
**Carroll Touch**  
811 Paloma Dr.  
Round Rock, TX 78664  
Tel.: 1-800-386-8241 or 512 244-3500;  
fax: 512 244-7040

CIRCLE NO. 165 ON FREE INFORMATION CARD

**AccuTouch, IntelliTouch**  
**Elo TouchSystems, Inc.**  
105 Randolph Rd.  
Oak Ridge, TN 37830  
Tel.: 800 356-8682 or 615 482-4100;  
fax: 615 482-4943

CIRCLE NO. 166 ON FREE INFORMATION CARD

**MagicTouch**  
**Keytec, Inc.**  
1293 N. Plano Rd.  
Richardson, TX 75081  
Tel.: 1-800-624-4289 or 214 234-8617;  
fax: 214 234-8542

CIRCLE NO. 167 ON FREE INFORMATION CARD

**QuickPoint**  
**MicroTouch Systems**  
300 Griffin Brook Park  
Methuen, MA 01844  
Tel.: 508 659-9000 or 508 659-9100

CIRCLE NO. 168 ON FREE INFORMATION CARD

**TrollTouch**  
**Troll Technology, Inc.**  
25020 W. Ave., Stanford, Ste. 110  
Valencia, CA 91355  
Tel.: 805 295-0770; fax: 805-295-0771

CIRCLE NO. 169 ON FREE INFORMATION CARD

#### Voice-Command Software

**Sound Blaster 16, VoiceAssist**  
**Creative Labs, Inc.**  
1901 McCarthy Blvd.  
Milpitas, CA 95035  
Tel.: 408 428-6600; fax: 408 428-6611

CIRCLE NO. 170 ON FREE INFORMATION CARD

**Rover for Windows**  
**Digital Soup, Inc.**  
PO Box 1340  
Brattleboro, VT 05302  
Tel.: 802 245-7356; fax: 802-254-6812

CIRCLE NO. 171 ON FREE INFORMATION CARD

**JustVoice for DOS & Windows****Interactive Products, Inc.**

1600 Valley River Dr., Ste. 170

Eugene, OR 97401

Tel.: 503 341-4964; fax: 503 341-4965

CIRCLE NO. 172 ON FREE INFORMATION CARD

**Pro Audio Studio 16; ExecuVoice****Media Vision, Inc.**

47900 Bayside Pkwy.

Fremont, CA 94538

Tel.: 510 770-8600

CIRCLE NO. 173 ON FREE INFORMATION CARD

**Sound System 2.0****Microsoft Corp.**

One Microsoft Way

Redmond, WA 98052

Tel.: 206 882-8080

CIRCLE NO. 174 ON FREE INFORMATION CARD

**Listen for Windows****Verbex Voice Systems, Inc.**

1090 King George's Post Rd., Bldg. 107

Edison, NJ 08837-3701

Tel.: 800 275-8729; fax: 908 225-7764

CIRCLE NO. 175 ON FREE INFORMATION CARD

**Voice-Dictation Software****Dragon Dictate****Dragon Systems, Inc.**

320 Nevada St.

Newton, MA 02160

Tel.: 800 825-5897 or 617 965-5200;

fax: 617 527-0372

CIRCLE NO. 176 ON FREE INFORMATION CARD

**Kurzweil Voice for Windows****Kurzweil Applied Intelligence**

411 Waverly Oaks Rd.

Waltham, MA 02154

Tel.: 800 380-1234 or 617 893-5151;

fax: 617 893-6525

CIRCLE NO. 177 ON FREE INFORMATION CARD

**Personal Dictation System****IBM Corp.**

Rte. 100

Somers, NY 10589

Tel.: 800 825-5263 or 914 766-1900

CIRCLE NO. 178 ON FREE INFORMATION CARD

**Miscellaneous****Interactive Brainwave Visual Analyzer****IBVA Technologies, Inc.**

249 E. 48 St.

New York, NY 10017

Tel.: 212 754-4282; fax: 212 759-5080

CIRCLE NO. 179 ON FREE INFORMATION CARD

about 70 words per minute. Besides English, it will soon support French, German, Italian, Spanish and British English.

*VoiceType* supports such speech-enabled applications as OS/2 PM Workplace Shell, System Editor, Communications Manager; Describe, *Lotus Notes*, *Lotus 1-2-3*, Microsoft Word and *WordPerfect* for OS/2 and *WordPerfect* for Windows 5.2.

The product also includes navigational tools that let you control your OS/2 system via voice commands. A Voice Action Editor lets you create macros to command your PC to perform a specific task, like printing a document, starting an application, sending a fax, etc. It can be used to navigate around OS/2 and certain OS/2 applications. For others, including Windows applications, you must develop your own voice macros.

A Windows version of the *VoiceType Dictation System* should be available late this year.

Dragon System's *DragonDictate for Windows* comes in a \$395 Starter Edition, \$695 Classic Edition and \$995 Power Edition, each offering a larger active vocabulary than the previous one. A noise-canceling microphone is included in each package. The software requires a steep learning curve to accurately match your voice with words. Once it has learned, it takes dictation at 40 words per minute.

The Starter Edition comes with a 5,000-word vocabulary and requires an 80486 PC with 12M of RAM to operate. The Classic Edition comes with a 60,000-word vocabulary and needs an 80486 with 16M of RAM.

*DragonDictate* has two modes of operation, one for dictation and the other for voice command and control. All editions work with several popular 16-bit sound cards, such as Sound Blaster, Pro Audio 16, Microsoft Sound System card and IBM's M-Audio card.

Kurzweil Applied Intelligence's \$995 *Kurzweil Voice for Windows* 1.2 discrete speech-recognition system is speaker-independent and features a large vocabulary with 30,000- or 60,000-word pre-defined dictionary. It's aimed at users who run popular Windows-based applications, such as word processing and spreadsheets. It automatically recognizes speech patterns and accents, allowing you to

transcribe spoken words to your PC to create a text file.

You need 8M of RAM for the 30,000-word active vocabulary and 16M of RAM for 60,000 words. Once up and running, the program takes dictation at up to 50 words per minute. The unique feature of the software is its ability to learn your voice as you work, becoming more accurate with continued use. Alternatively, you can read from a list of 400 words.

The price of *Voice for Windows* includes the Mwave WindSurfer sound card from IBM, software and a headset microphone. The sound card also doubles as a fax/modem and DSP-based voice messaging and answering system and is MPC-compliant.

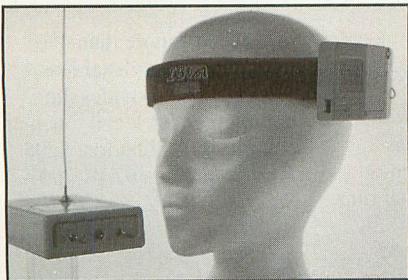
*Voice* directly supports current versions of Windows-based applications from *WordPerfect*, *Lotus*, *Software Publishing*, *Microsoft* and *Quicken*. You can voice-enable additional Windows-based applications and new versions of applications via an easy-to-use command editing interface. It can also be used as a voice command and control program.

With the coming enhancements of the OS/2 and Windows 95 operating systems, it's quite probable that voice recognition will be a standard feature on new PCs. RSIs, such as carpal tunnel syndrome, may then be replaced by a hoarse voice.

**In Closing**

I've defined a serious problem facing all of us as we become more and more dependent on personal computers. I've outlined some alternatives that can decrease the cause of RSI and will, hopefully, help you if you're currently afflicted with RSI and help those of you who aren't affected to decrease your exposure to RSI by changing or varying the way you use your PC.

Perhaps someday you'll be able to just think commands and input to a personal computer. That day may not be so far off. New York-based Interactive Brainwave Visual Analyzer (IBVA) Technologies offers an interactive brainwave visual analyzer for the Macintosh. The \$1,295 single-channel or \$2,295 two-channel system employs a lightweight headband to capture brain activity and transmit it to a receiver attached to a Mac in



IBVA Technologies Interactive Brainwave Visual Analyzer.

real time, where it's converted into digital signals that can interact with applications and almost any electronically addressable device, or you can store them for future use.

One prototype car-racing game uses the headband as an input device. When you relax, the car speeds forward. Tense up, and it runs out of gas. This easy-to-use electroencephalograph (EEG) that you can program to read muscle movements (EMG) and heart rate (EKG) and link this data to other software tantalizes one's imagination.

Individually, the alternative input devices I've discussed here may not prevent or alleviate the damage caused by long hours at your PC. However, when integrated with other devices, each can lead to reduction of the repetitive finger and hand actions that cause RSI. You're cautioned to bear in mind that no input device should be considered the be-all and end-all, however. You should take a systems approach to preventing RSI by looking at the whole body, the whole workstation and the way you work.

More important than any single device is having a completely adjustable personal-computing environment that includes a desktop you can raise or lower as needed and a fully adjustable chair. The workstation should adapt to your needs and size, rather than you having to adjust to it.

Alternative input devices can give the fingers and wrists a rest or at least change the positioning of them to avoid the repetitive motions that result in RSI.

The key to preventing and treating RSI is taking charge of the way you work. Taking breaks, stretching and even warming up your typing muscles are as important as ergonomic computer accessories and alternative input devices. ■

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## WHAT'S NEW! (from page 104)

### DesignCAD for Windows

*DesignCAD Windows* from American Small Business Computers is a computer-aided-design program that runs under Microsoft Windows. It lets you open an unlimited number of views, at any size and placement. The program lets you draw and set points from view to view. You can open the program multiple times to work on more than one drawing simultaneously. A Hot Tool Box lets you place most-used commands so that they're instantly available.

*DesignCAD Windows* contains 256 named layers and 256 colors from a palette of more than 16-million. Also included is *BasicCAD* a BASIC-like CAD programming language with access to all *DesignCAD* commands. \$349. *American Small Business Computers, Inc., One American Way, Pryor, OK 74361; tel.: 918-825-7555; fax: 918-825-6359.*

by a ratio of more than 4:1 with little or no visual loss. *Smacker* also provides the ability to go back and touch up compressed animation. \$295. *RAD Software, 307 W. 200 S., Ste. 1003, Salt Lake City, UT 84101; tel.: 801-322-4300; fax: 801-359-6169.*

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### Personalized Greeting Cards

*Greeting Card, Etc. for Windows* from Fintech Software lets you create personalized greeting cards for a wide variety of occasions. The package includes 48 greeting cards in 24 different styles, with pre-printed colorful artwork created by artists who create cards for large greeting-card publishers. Cards are made of the same stock as store-bought ones. You can select from more than 650 professionally-written poems, verses, jokes and sentiments, or you can make up a verse yourself. The program also includes a wide selection of clipart images and can accept images from popular paint programs. \$59.95. *Fintech Software Corp., 201 Eagle Bay Dr., Ossining, NY 10562; tel.: 914-923-4611.*

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### Universal Picture Viewer

*Oogler 1.0 for Windows* from Inset Systems provides access to images from a large variety of software packages. Its list of supported formats includes the most popular formats for MS-DOS, Windows and OS/2, as well as formats commonly found in Macintosh, Amiga and Sun environments. Once an image is opened in *Oogler*, zooming tools are available for close-up viewing. \$37.50. *Inset Systems, 71 Commerce Dr., Brookfield, CT 06804; tel.: 203-740-2400; fax: 203-775-5634.*

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*ID Technology's ExpressDecoder* is proprietary decoder software for inputting bar-codes into laptop and PC computer systems. Available with the software is a pen-type wand that plugs into the parallel or serial port interface. The software lets you enter data directly into an application program via the wand. A special power-management system built into *ExpressDecoder* eliminates the need for an external power supply. \$249. *ID Technology, 655 N. Berry St., Ste E, Brea, CA 92621; tel.: 714-990-1880; fax: 714-990-2503.*

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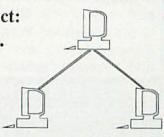
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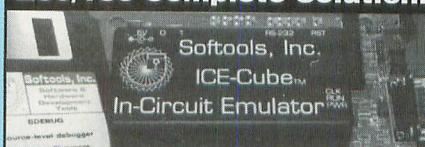
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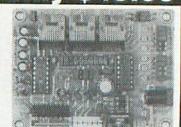
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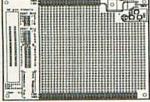
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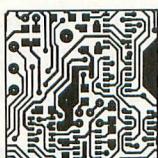
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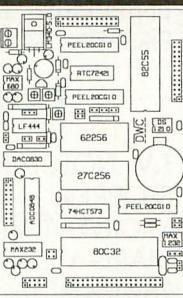
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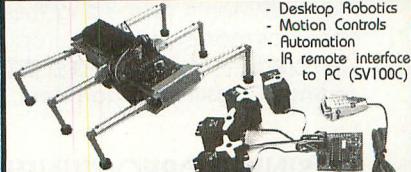
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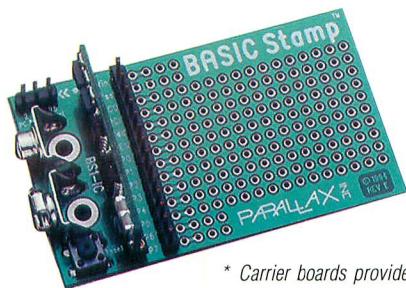
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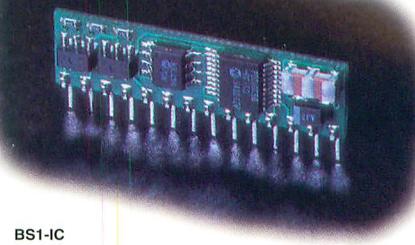
Stamp-sized modules run BASIC



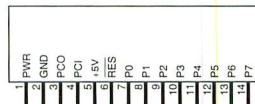
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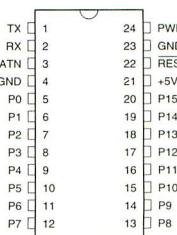
\* Carrier boards provide battery clips, prototyping area, programming connector, and reset button (BS1-IC carrier shown).



BS1-IC

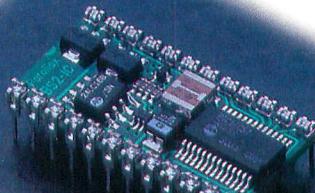


BS2-IC



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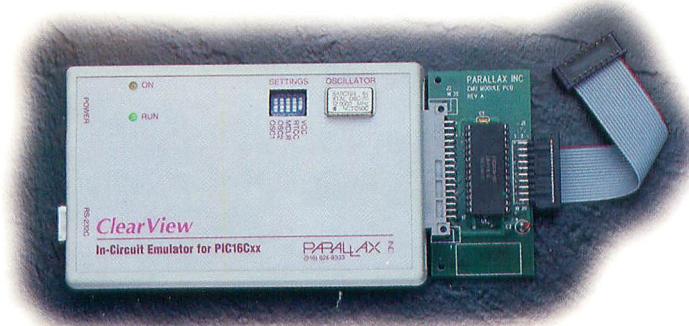
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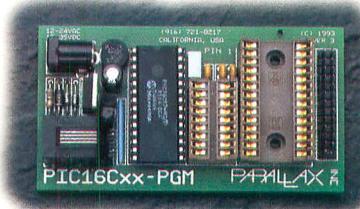
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